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Survey of open source integrated library systems

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SURVEY OF OPEN SOURCE INTEGRATED LIBRARY SYSTEMS

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ABSTRACT

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The purpose of this study is to compare integrated library system (ILS) costs and benefits, and to inform librarians about considerations when choosing between an open and a closed source ILS. A survey was conducted among libraries that used the largest open source ILSs, Koha and Evergreen, and various proprietary ILSs. Questions were asked about initial and annual costs. Questions about benefits took the form of satisfaction ratings. The questionnaire also asked why the ILS was selected, whether it was customized, who hosted and serviced it, what problems were encountered, and library demographics.

The survey found that open source ILSs were more cost-effective than proprietary ILSs. Libraries using open source ILSs chose them mainly for affordability, and they cost less than proprietary ILSs. Although users of open source ILSs experienced difficulties with installation and incomplete documentation, they were modestly more satisfied than users of proprietary ILSs.

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Introduction

General Description of Area of Interest

The main type of software in use in libraries today is the *integrated library system* (ILS), which is the modern equivalent of the card catalog. An ILS provides a search interface to the library catalog and automates library tasks such as the tracking of book loans and returns. Although ILS vendors have added many different features, every ILS has nearly the same core components of cataloging and circulation tracking.

Because the ILS core is stable, it is suitable for collaborative development. Collaboratively developed computer programs are known as *free software* or *open source software* (OSS). Librarians and programmers have worked together to produce several open source ILSs. Users and developers are free to share and change open source programs, a practice similar to sharing recipes. In OSS the sequence of humanly readable computer instructions, known as *source code,* is open to view. Open source licenses ensure that OSS and its derivatives may be freely viewed, used, copied, modified, and redistributed (Open Source Initiative, 2006). Examples of well-known OSS include the Mozilla Web browser, Apache Web server, and Linux operating system.

Open source ILSs are new compared with proprietary ILSs and share less than two percent of the ILS market (Breeding, 2007a; Pace, 2005). Vendors of proprietary ILSs do not allow users to view the source code, copy, or customize it. However, proprietary ILSs are mature turnkey products whose use requires little technical knowledge. OSS is of potential interest to librarians because libraries might save money by using it, they may customize it, and because the open source community and

librarians share the same values of equal access and freedom of information.

The purpose of the study is to inform librarians about what considerations to make when choosing between an open and a closed source ILS. The study investigates why some libraries have chosen an open source ILS and compares the costs and benefits of the open source ILS with those of a proprietary ILS. Librarians using both open source and closed source ILS software will be surveyed.

The precursor of OSS was free software, meaning *free* in the sense of liberty to view and modify the source code. Users were free to participate in developing and changing the software. Advocates of free software emphasized its freedoms and unfettered access. In English, the word *free* also means *no cost*, but this is not its intended meaning in the term *free software*. A group of software developers and users later adopted the term *open source* because it is more business-friendly (Williams, 2002, chap. 11). Despite their origins, both terms have come to connote low cost. Free software and open source software are nearly the same for practical purposes. Both are often licensed under the same General Public License (Free Software Foundation, 1991). A term containing both concepts is *free/open source software (F/OSS)*, but for brevity this paper uses *OSS*.

Often cited advantages of OSS are low cost and freedom from vendor lock-in. Because few libraries use open source ILSs, little empirical data exists about their use. Whether open source ILSs cost less than proprietary ILSs is an open question. OSS is generally thought to cost less than proprietary software, but the impression might be misleading. Reported disadvantages of OSS are less ease of use and more need for

technical expertise. The materials costs of OSS are low, but the labor costs of OSS might be higher. On the other hand, freedom from vendor monopoly allows competition among service contractors, which helps to keep labor prices down. Other reported strengths of OSS include customizability, portability, and security. Free and open source software are the most permissive types of software for users. By contrast, proprietary software is the most permissive for software owners, as shown in Figure 1.

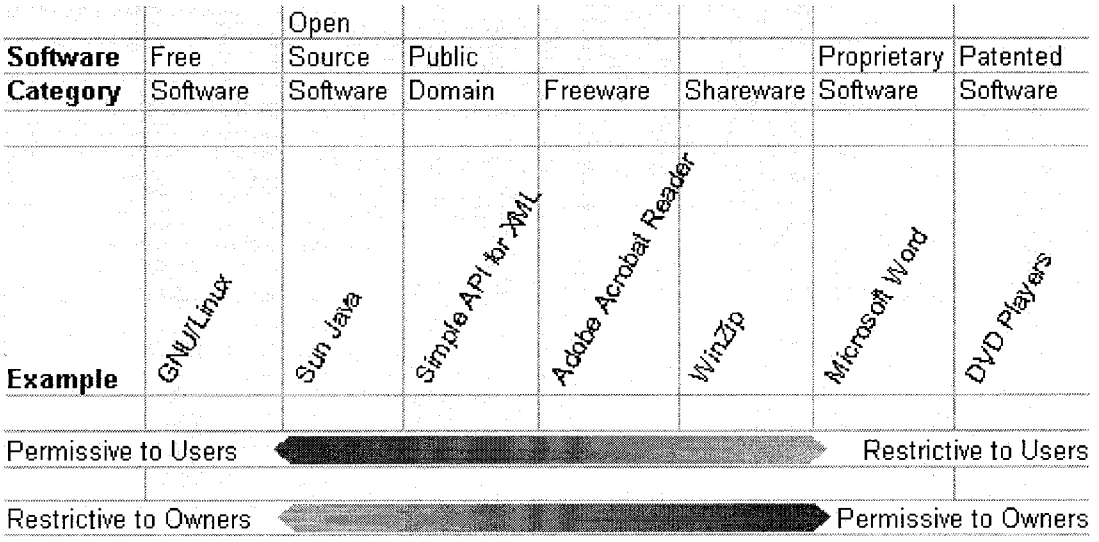

Figure 1. Software classified by category of intellectual property.

OSS has no licensing fees and is not protected by a traditional copyright restriction. A library district using an open source ILS would pay the same materials cost for several branch libraries as it would pay for one library. In contrast, a library district using a proprietary ILS might pay per-site fees based on the number of libraries or computers. A common license for OSS is the General Public License (GPL). Under this contract, which gives permission to copy, distribute, and modify a computer

program, the software and its derivative works cannot be patented or made proprietary. A fee can be charged for distribution or technical support of OSS, yet a free version of OSS is usually available by download or compact disc.

Libraries use computers to efficiently acquire, organize, retrieve, and disseminate information. OSS has been developed to facilitate many library-related tasks such as cataloging photographs and managing bibliographies. An ILS is a database of a library collection and patron accounts, and the procedures acting on it. It may contain functional modules for cataloging, circulation, serials, acquisitions, statistical reports, patron accounts, and an online public access catalog (OPAC, i.e., catalog search engine). *Integrated* refers to the ability of the system to share data among its modules. For example, the information to order a book may be entered in the acquisitions module, which may be used by the cataloging module, and searched via the OPAC. This integration reduces redundant data and effort. A synonym for ILS is library management system (LMS).

ILSs vary by factors including scalability, database type, operating system compatibility, support for machine-readable catalog (MARC) record formats, and interoperability with other library networks and articles databases. These factors can be influenced by whether an ILS is open source or proprietary. Pure open source systems rest on open source platforms and components. Therefore, some open source ILSs run only on the Linux operating system, but not on Windows. The open source database MySQL is used in several open source ILSs. MySQL was originally smaller and slower than the proprietary database Oracle. However, its use storing metadata in YouTube,

which has served 100 million videos per day since July 2006, has put doubts about its scalability and performance to rest (Do, 2007; Hoff, 2008). Proprietary ILSs have a well-established market and outpace open source ILSs in many features such as catalog integration with online journals and multimedia.

Open source ILSs include Avanti MicroLCS, Emilda, Evergreen, Gnuteca, Koha, OpenBiblio, PhpMyLibrary, and PhpMyBibli (Corrado, 2004). However, most libraries use proprietary ILSs such as Innovative Interfaces Millennium and SirsiDynix Horizon (Breeding, 2007a; Pace, 2005).

Problem to be Investigated

This study will investigate why some libraries have chosen an open source ILS and will compare open and closed source ILSs on costs and benefits. The potential benefits of an ILS include specific advantages of open and closed source software as well as general benefits of all software. Table 1 lists the benefits of each type.

Table 1.

Software Benefits

Open Source	Proprietary	General
Affordability Customizability Portability No vendor lock-in	Turn-key Advanced features Scalability	Reliability Performance Ease of use Support Documentation Interoperability Security

An objective of this study is to discover what priority libraries give to each of these benefits and how well ILSs meet libraries' needs on them. The study will also analyze

ILS costs in terms of initial and perpetual costs, and in terms of materials and labor.

The hypothesis of this study is that an open source ILS is more cost-effective than a proprietary ILS. In other words, the null hypothesis to disprove is that an open source and proprietary ILS are the same in terms of cost-effectiveness.

Significance of Problem and Justification

Libraries are concerned about cost because they often have more demands than resources, they are funded by their communities, and they have a responsibility to manage community funds wisely. If libraries can serve their communities' needs at a lower cost by using OSS rather than proprietary software, it would be in their interest to adopt it. Minimally funded libraries, such as small libraries and libraries in rural areas and developing countries, may find OSS affordable. Library decision makers are concerned about the total cost of ownership of an ILS. This includes costs of installation, documentation, training, support, and maintenance.

After an ILS is selected, a library needs to protect its investment. If the vendor of a proprietary ILS goes out of business or discontinues support of a product, the library loses its investment of time and funds in the ILS, must choose a new ILS, retrain staff, and transfer catalog records to the new ILS. In contrast, a library using an open source ILS may not have to do any of these things. If the support firm of an open source ILS ceases operation, the library must choose another source of support, but may have more than one option, including internal support. By using an open source ILS, a library may reduce its dependence on a vendor.

To meet the changing needs of users and to make use of new technologies, a

library may wish to customize or upgrade its ILS. It is unknown how much significance libraries attach to customizability. If an ILS is proprietary, a library is prohibited from changing it and must ask the vendor to change it. If an ILS is open source, a library may change it or outsource the changes to a contractor of their choice.

The next section describes the history of OSS and its adoption in libraries. The timeline ends with the current status of Koha and Evergreen, the most widely used open source ILSs. Following the history is a discussion of the larger context of open information models, including open source and open access. The last part of the paper reports a survey experiment on open source ILSs.

Literature Review

History

"Software sharing is as old as computers" (Stallman, 2002, p. 8). Early computers were developed in research laboratories, where they were the subject of academic study. Computer scientists stored programs and data in electronic, digital form. As computer storage technology evolved from punched cards to tape and discs, digital media became easier to copy and share. Researchers in academic and scientific institutions shared software before it became commercialized and proprietary. This history chronicles how the open source model started, grew, and came to be used in libraries.

Early examples of open source software and archives are Netlib and Ibiblio. Netlib is a collection of mathematical software accessible since 1984 on the Internet (Dongarra, Golub, Grosse, Moler, & Moore, 2006). Ibiblio, formerly known as SunSITE, founded in 1992, is an archive of OSS hosted by the University of North Carolina, now mirrored by sites on six continents. This repository also hosts other open media collections: music archives, text databases, and special exhibits (Ibiblio, n.d.).

When computing passed from early research to commercial uses, many software producers restricted copying of software and prevented access to source code. The prohibition of software exchange sometimes led programmers to circumvent it by reverse engineering binary code. Proprietary vendors hid source code and profited by charging license fees. Richard Stallman, an early proponent of free software, stood against this trend. He was a systems programmer at MIT in 1982 when the laboratory he

worked in replaced its shared operating system with a proprietary system. He described the new situation as follows: "The first step in using a computer was to promise not to help your neighbor. A cooperating community was forbidden. The rule made by the owners of proprietary software was, 'If you share with your neighbor, you are a pirate. If you want any changes, beg us to make them'" (Stallman, 2002, p. 9). Stallman challenged this policy. He declared that "Computer users should be free to modify programs to fit their needs, and free to share software, because helping other people is the basis of society" (p. 11).

One of Stallman's formative professional experiences was an encounter with a Xerox printer that continually jammed. When he wished to modify the printer driver, Xerox would not release the source code. He could not use a friend's copy, because the friend had signed a nondisclosure agreement (Bretthauer, 2002). Frustration ensued because the technical capabilities of the computers owned by his organization were stymied for nontechnical reasons. In 1985 Stallman founded the Free Software Foundation. Its object was to create free software, including a free operating system, GNU (a recursive acronym for "GNU's not Unix").

An early operating system, Unix, began as a proprietary system and eventually spawned an open source version, Linux. A multi-user system that existed before Microsoft Windows, Unix was originally developed by Ken Thompson and Dennis Ritchie at AT&T Bell Laboratories in the 1960s and 70s. Development of Unix continued at UC-Berkeley resulting in the Berkeley Standard Distribution. Unix was widely used in universities by computer science students and is many programmers'

operating system of choice, due to its transparency and powerful functionality for skilled users. However, when students left the university, they no longer had access to their familiar development platform. In 1991 a student at the University of Helsinki, Linus Torvalds, developed Linux, which was a Unix operating system built on his personal computer from scratch, free of proprietary sources.

The coincidence of the GNU project needing a kernel (operating system nucleus) and Torvalds finishing his project near the same time resulted in his contribution of the Linux kernel to the GNU system. The combination of GNU and Linux was a software platform, free from the ground up, with no layers of proprietary software hindering redistribution or modification. It was the first open source version of Unix that could be run on personal computers.

Berkeley also contributed source code by releasing its Transmission Control Protocol/Internet Protocol (TCP/IP) as freely redistributable in 1989 (Bretthauer, 2002). The TCP/IP protocol runs on all computers that communicate on the Internet, including Web servers and personal computers. The first major open source product that came to the attention of nonprogrammers was the Netscape Web browser. In 1997 Netscape released their browser at no cost for the general public, and a few months later, released the source code (Open Source Initiative, 2005). After Netscape discontinued development, the open source community carried on support of this project as the Mozilla browser.

Linux is one part of a development paradigm known as LAMP, which is a group of open source components for developing Web and database applications such as

library OPACs. LAMP stands for Linux, Apache, MySQL, and PHP/Perl/Python, each of which is open source. Raymond (2001) believes the Linux operating system is the most successful example of OSS, due to its name recognition and large developer community. Today, Linux is estimated to have several million users (Linux Counter, 2005), although it is difficult to know exactly how many free copies have been downloaded or shared.

Other examples of OSS used in production environments are TCP/IP and Apache. The Netcraft Web server survey (2007) reported that the Apache Web server, which was released in 1995, held at least 50% of the market share of Web servers from 1996 to 2007, peaking at 71% in November 2005. In March 2008 the largest shares of the Web server market were held by Apache with 51% and Microsoft with 36%.

The term *open source* was coined by Christine Peterson in 1998 (Bretthauer, 2002), and the adopters of the term formed the Open Source Initiative. Part of the free software community began using the term *open source software* rather than *free software* so that *free* as in *liberty to copy or modify* would not be confused with *free* as in *free of charge*. Another aim was to appeal to and avoid alienating for-profit businesses.

Stallman (1999, p. 69) acknowledged the former reason as a valid goal, but rejected the for-profit issue, which he felt corrupted the spirit of the free software movement. He objected that OSS allows the "inclusion of proprietary software and ignores the philosophical issue of software freedom" (Bretthauer, 2002). Eric Raymond, a proponent of open source, believed the best aspect of OSS was its superior engineering quality, owing to the large number of collaborators who could improve the software.

Stallman (2002, p. 82) pointed out that makers of proprietary software could use the same argument of software quality, and he preferred to emphasize the freedoms of free software.

OSS is compatible with commerce. Raymond (2001) presented business models for supporting OSS. Rather than sell the software, open source businesses may sell services such as assembly, installation support, and continuing support contracts while permitting free use, distribution, and modification of the software. For example, the publicly traded Red Hat company provides a packaged, precompiled (i.e., ready-to-run) version of Linux with documentation, training, and service agreements, yet the source code is subject to the open source license clause allowing free distribution (Red Hat, 2005a, 2005b).

The evolution of commercial open source companies has not been without controversy. Some commercial firms use the term *open source* mainly as marketing cachet, but engage in business practices that are not aligned with open source principles, such as charging subscription fees in place of license fees for bug fixes, while obscuring information about locating the source code of the fixes. If most of the development of an open source project is controlled by a commercial company to serve its largest clients, the benefit to the original community of users may be lost (Moczar, 2005). Perhaps the most democratic, community-oriented open source projects are those guided by nonprofit foundations, which coordinate efforts and advocate for developers and users.

Raymond (2001) emphasized the expansion of open source development from its beginnings in core computer science tools to a variety of uses in many disciplines. He

noted that as software tools become standardized as homogeneous commodities, they are ripe for open source development. This trend coincides with findings by Pace (2005, p. 25), who surveyed libraries on their ILSs. He observed the "commodity-like nature of basic ILS functionality" and the "commodified similarities of a wide range of library automation systems."

The library community first began to take note of OSS in 1999, when Daniel Chudnov, founder of the Open Source Systems for Libraries project, wrote an introductory article in *Library Journal*. Chudnov mentions three library-related OSS projects: an interlibrary loan document delivery system at Ohio State University, an automated linking system to electronic resources at Yale, and a draft of an ILS by Frumkin at the University of Arizona.

Chudnov (1999) notes similarities between philosophies of librarians and advocates of OSS. Both seek to share resources and contribute to their communities. Appealing to their common belief in freedom of information, he cites a quote from Stallman, "libraries should actively discourage the concealment of generally useful knowledge, and that includes proprietary software" (p. 41). It is possible to interpret this as encouraging theft, but since Stallman founded the Free Software Foundation to provide an alternative to proprietary software, it is likely that he is merely discouraging the use of proprietary software (Stallman, 2002, p. 58).

Chudnov observes that librarians have been more cautious in their consideration of OSS than other library issues such as intellectual freedom and disability access. One possible reason for this reluctance, he speculates, is the perception that "you get what

you pay for," in other words, "purchase legitimizes quality." However, there are certainly counterexamples to this adage. For instance, in February 2008, Netcraft rated Web hosting companies by fewest failed network requests. Seven of the top ten ran on open source operating systems (Linux or FreeBSD), and only two on a proprietary operating system (Microsoft Windows).

To promote OSS, Chudnov (1999) suggested that library system vendors release their source code and sell service contracts. He urged librarians to take part in shaping open source library software by helping with evaluation and documentation.

Tennant (2000a, 2000b, 2003), a user services and information systems librarian, continued the advocacy of OSS for libraries. He encouraged librarians to install OSS on a trial basis. Tennant asserted that open source is better than proprietary software because libraries may alter it to meet their needs, and such alterations may benefit other libraries as well. However, he noted that small libraries were unlikely to have technically sophisticated personnel who could install and maintain OSS, and large libraries exceeded the scalability limits of open source ILSs at the time.

Cervone (2003) and Buchanan and Krasnoff (2005) considered advantages and disadvantages of OSS for libraries. One advantage of OSS is portability. The source code can be compiled for any combination of hardware and operating system. For example, Koha (www.koha.org) is supported by vendors for Linux and Windows, and has an informal, unsupported version for Mac OS X. Disadvantages of open source, which are especially applicable if the software has a small user base, include a lack of peer review, timely bug fixes, and support. Despite these, use of open source has grown

in libraries, in evidence by the dozen library-related OSS applications that Cervone mentions.

Since the late 1990s, several open source ILSs have been developed (Boss, 2005). While open source ILS developers have been struggling to provide basic features, proprietary ILS vendors surpass them with increasingly complex features such as live chat reference and video, making it difficult for OSS to enter the ILS market (Breeding, 2002). The most widely used open source ILSs are Koha and Evergreen.

A group of four rural libraries in New Zealand contracted in 1999 to develop Koha. Libraries were slow to adopt Koha, in part due to its original lack of MARC support, the standard international format for bibliographic catalog records (Hedges, 2003, 2005). The first public library in Northern America to adopt it funded the development of MARC compliance and began using Koha in 2003. Koha is now used worldwide, mainly in small libraries (Breeding, 2007b; Koha Developer Wiki, 2007).

Evergreen (open-ils.org) is an open source ILS that was developed beginning in 2004 by a consortium of public libraries in Georgia. It had been installed in 265 libraries by the time of this study. The source code is available for download under the GNU GPL. The consortium believes their ILS will lower costs of software maintenance, licensing fees, and hardware.

The availability of OSS in libraries today is due to the contributions of librarians, programmers, volunteers, and sponsoring libraries, many of which are funded by the public. OSS was originally developed, used, and shared by computer scientists. The first instances of OSS were technical applications: compilers, operating systems, and

networking tools. Enabled by the Internet, open source developers collaborated globally. Expansion of OSS to libraries was made possible by the commoditization of ILS functions and standardization of bibliographic record format. Past successes and failures of open source in technical applications provide a framework of advantages and disadvantages against which to evaluate open source ILSs.

Theory Identified as Framework for Research

The potential advantages and disadvantages of library OSS form the basis for inquiry. This study will investigate how these factors affect libraries' selection and use of an open source ILS. Potential advantages of OSS are:

- Lower costs
- Ease of licensing restrictions
- Customizability
- Portability
- Code peer review (if a large enough user base)
- Opportunity to contribute to ILS code base
- Flexibility in choosing a service contractor

Potential disadvantages are:

- Need for technological sophistication
- Higher labor costs
- Lack of scalability
- Fewer advanced features

Open source projects with large communities benefit more than small ones from code peer review. For example, the Linux community has produced many manuals, bug fixes, software upgrades, Web discussion forums, install fest events, etc. However, open source ILSs have smaller communities and fewer resources to keep up with demands for bug fixes and new features.

Raymond (2001) warns against the dangers of proprietary software vendor lock-in. A user of proprietary software has only one source for bug fixes, feature enhancements, or adaptation to new platforms as technology changes. His investment, including costs of new equipment, staff training, and data migration, is lost if the vendor does not perform.

Security is important to software users. Confidential data in libraries include patron contact information and circulation records. It is unknown but much debated whether open or closed source software is more secure. Vendors of proprietary software claim that hiding the source code keeps it safe, whereas revealing the code leaves it vulnerable to crackers (i.e., those who would exploit the software to cause computer viruses). Open source proponents counterclaim that many independent developers search for security holes to plug them, and that the more eyes examining the code, the more quickly vulnerabilities are found and fixed. Comparisons of the security of open and closed source software have been inconclusive.

While paid technical support may be available for OSS, a benefit of OSS is the free support found in Internet mailing lists and discussion forums. A paradox exists about technical support and why open source ILSs are not quickly adopted by libraries. Libraries hesitate to adopt OSS if technical support is inadequate, but technical support is likely to remain sparse until more libraries adopt OSS.

Open Information Models

Open source is one of many open information models, including open standards, open access publishing, open data, and open courseware. Although seen as alternatives

to established means of information sharing, these models are based on values similar to traditional principles of librarianship and copyright law. Both librarianship and open source have met challenges to freedom of information and access. In particular, open source faces a threat from patents. This section will look at what open information models have in common with traditional models of access and distribution, and will discuss challenges common to libraries and open information models.

The purpose of open information models is to increase access and decrease cost. Open information models share values with freedom of information laws, public broadcast media, the American Library Association (ALA) code of ethics, and the original purpose of copyright law in the U.S. constitution. Barriers to information access are often due to economic conflicts with distributors who put profit before public access.

Traditional principles and open information models. The ALA Code of Ethics (2008) sets forth values of equity of access and intellectual freedom. Chudnov (1999) observes that libraries and open source serve their communities in similar ways. Both are public works that make materials available collectively beyond what people could afford individually.

The ideals of the open source community are similar to those of Ranganathan, a librarian whose contributions to librarianship included promoting public libraries in India. He said, "the vital principle of the library ... is that it ... freely distributes all the tools of education and disseminates knowledge with their aid" (1931, p. 415). Ranganathan's renowned five laws of librarianship express values central to the library profession. Cana (2003) analyzed the congruence of open source with Ranganathan's

laws and wrote laws of open source that parallel Ranganathan's such as "Software is for use." Gorman (1995) offered an update of Ranganathan's laws. His modernized restatement could also be applied to open source: "... serve humanity," "protect free access to knowledge," and "use technology intelligently to enhance service."

Developers and users share and improve OSS for the benefit of society. As a vehicle for collaboration, the idea of open source agrees with the original intent of the clause in the U.S. constitution to "promote the progress of science and the useful arts" (U.S. Const., art. I, § 8, cl. 8). It also accords with the initial aim of intellectual property (IP) law, which was to encourage people to "build freely upon the ideas and information conveyed by a work" rather than to "reward the labor of authors" (*Feist Publications, Inc. v. Rural Telephone Service Co.*, 1991, ¶ 19). IP law affects the sharing of ideas and has been the subject of controversy concerning patents and open source.

When the U.S. constitution was written, the government conceded patents for a limited time monopoly (now about 20 years) to inventors as an economic incentive. Jefferson, the first patent system administrator, felt that it was not a natural right of people to own an idea, and he was therefore reluctant to grant patents. An inventor himself, he never patented any of his ideas, because he felt such monopolies were wrong. To Jefferson, ideas were part of a flow of give and take: an idea does not spontaneously arise in a solitary mind. We take ideas from others:

> ... One new idea leads to another, that to a third, and so on through a course of time until some one, with whom no one of these ideas was original, combines all together, and produces what is justly called a new invention. (Jefferson, 1818/1905, p. 88)

And we give ideas to others:

> He who lights his taper at mine, receives light without darkening me. That ideas should freely spread from one to another over the globe ... seems to have been peculiarly and benevolently designed by nature, when she made them, like fire... (Jefferson, 1813/1986, ¶ 1)

Similarly, Stallman (2002, p. 55) noted that software resembles energy more than tangible property, because transferring it does not deprive an owner of possession.

Patents are incompatible with open source. In the early years of the U.S. patent office, patents were granted only for inventions that were leaps of scientific progress. Before 1980, software was generally not patentable, because it was considered equivalent to mathematical algorithms. As time went on, court rulings set legal precedents that loosened patent standards. The scope of patents broadened to encompass software, business methods, and genes. Gradually the scientific standard of showing an invention was novel and nonobvious shifted to a legal standard of showing there was no prior patent. Patent creep led to patent inflation.

Ironically, although a patent application reveals an invention, a patent grant inhibits use of the invention. Rather than encouraging openness and sharing, patent laws now further the aims of corporations over the rights of individuals (Torvalds & Diamond, 2001, pp. 210, 214). The patent system has become a battleground of corporate interests that flood the system by practicing defensive patenting to amass portfolios of patents. These patents function as bargaining chips for cross-licensing in case of patent infringement claims. The portfolios are an IP landmine for competitors who stumble upon a patent by independently reinventing it in the normal course of work. In 2006 the

U.S. Patent and Trademark Office reported a record 173,772 patents granted, which is a 21% increase over 2005. Of these, IBM was granted the most patents with 3,651, and Microsoft was granted 1,463 patents in 2006 (Gruener, 2007).

The patent system has been abused by applications for trivial software patents such as the not equals sign (Bergstra & Klint, 2005). Bessen and Hunt (2004, p. 47) estimate that 1,080 software patents were issued in 1980, growing to 24,891 in 2002. Software patents are incompatible with open source because they exclude everyone except the inventor from the right to use, make, or sell the software. However, inventors may give permission to exercise these rights through licenses. The common open source license GPL requires that any patented software it covers must be licensed for everyone's royalty-free use.

Software patents pose a challenge to open source developers because patents are more difficult to overcome than traditional copyrights. Although identical copying infringes copyright, developers may write code from scratch to avoid copyright infringement. However, inventing around a patented method requires greater ingenuity because a patent is tied to the method itself, rather than the expression of it as in copyright. Software that has become an industry standard may be patented, preventing its use in OSS. For example, MP3 audio clips may not be used in OSS because this would infringe on the patent held by Fraunhofer, which expires circa 2011–2017 (TuneQuest, 2007). Until then an alternative open source audio format, Ogg Vorbis, is available but not as popular.

Excessive IP protections are barriers to intellectual freedom and information

access. Although companies may return IP revenue to fund research and development, some studies cautiously suggest that high rates of patenting hinder scientific progress (Murray & Stern, 2005; Sampat, 2006). In the life sciences, the royalty fees of patents on genetic materials increase the cost of medical tests and cures beyond affordability for researchers and patients. Information stakeholders have urged reform of the patent system (Federal Trade Commission, 2003; Knuth, 1994). A ruling to tighten patent standards retroactively (*KSR International Co. v. Teleflex Inc. et al.*, 2007) might signal that the U.S. Supreme Court has taken notice.

Open standards. Open standards are specifications such as equipment sizes, data formats, and network protocols. The purpose of open standards is to facilitate interoperability and communication. Like open source, open standards can be developed and used without significant price barrier. Ideally, members of open standards committees represent a financially neutral public interest.

The earliest example of an open standard for libraries was the size of catalog cards. This decision was made at the first ALA meeting in 1877. It enabled mass production of catalog cards and cabinets (Coyle, 2002). A modern example of an open standard used in libraries is the MARC record format. Any vendor may implement the MARC standard, and there is no fee to use it. A MARC record created by a cataloger in one library can be read by a patron in any other library that uses MARC-compliant software, even if the reading software is made by a different vendor. Contrast this with a proprietary standard such as the Microsoft Word .DOC format. If a user exchanges a Word document with a user on a non-Windows system, the Word document may not

display or print properly. Developers have tried to overcome this incompatibility by reverse engineering the Word document format, but not always successfully.

Coyle (2002, ¶ 3) distinguishes between motives for open and closed standards, "If you need to compete, then openness is a disadvantage. If you need to cooperate, then openness is the way to go."

Open access. To serve their communities, librarians are challenged to balance library budgets with increasing journal prices. From 1984 to 2004, journal prices increased about 500%, or 9.36% per year (Dingley, 2004, p. 8). Meanwhile, the total materials expenditures of academic libraries increased just 250% (Association of Research Libraries, 2008), and the Consumer Price Index increased only 82% (Bureau of Labor Statistics, 2008). Amid this serials crisis, an alternative that has helped scholars and libraries is open access publishing.

During the 1960s, the U.S. government increased funding to university research, thereby increasing the number of researchers and articles published. Scientific journal publishers such as scholarly societies and university presses, which were mainly nonprofit, could not keep up with the increased literary output. Hence commercial publishers entered the academic journals market. Because scholars need to keep abreast of their fields, the demand for journals is high, and because research articles are unique, their content has no substitute. Thus price inelasticity is taken advantage of by commercial publishers to set profit margins for scientific journals as high as 42% (Kirby, 1997; Snoddy, 1997).

Commercial publishers took over the majority of scholarly publishing (House of

Commons Science and Technology Committee, 2004, p. 13) and consolidated their firms by mergers and acquisitions. The resulting small number of large publishers holds a near monopoly on scholarly publishing, limits competition, and fixes prices artificially high (Case, 2004; Hane, 2003; Kutz, 2002). The large publishers offer *big deals* of bundled electronic journals to libraries. Librarians who subscribe to big deals have trouble learning the prices of individual journals and lose flexibility in choosing journals. In response to out-of-control serials prices, academic librarians canceled nonessential journals, decreased monograph budgets, developed collections collaboratively, and joined consortia to purchase online full-text access. Before canceling journals, librarians asked faculty which journals were indispensable and apprised university administrators that budgets were not enough to maintain service levels. Thus, scholars became aware of the serials crisis.

Scholars who were authors and referees asked themselves why they provided free labor to commercial publishers who charged high prices and put profit before scholarship (Bergstrom, 2001). Scientists signed open letters to boycott high-priced journals like Elsevier's *Cell Press* (Walter & Yamamoto, 2003), and the editorial boards of several journals mutinied to start their own journals. Among them, most of the editors of the *Journal of Academic Librarianship* resigned after a subscription price increase by Elsevier, and some of the editors then created *Portal: Libraries and the Academy* at Johns Hopkins University Press (Suber, 2006). Enabled by the Internet, scholars have reclaimed some control of their literature by containing costs in nonprofit publishing. One way to regain affordability in journals is open access.

Open access is freely available, unrestricted access to scholarly information on the Internet. It has two main variants: archives and journals. Authors may self-archive papers on their websites or in long-term repositories of their subject area or institution. About half of traditional journals allow self-archiving (Gadd, Oppenheim, & Probets, 2003, p. 26; McVeigh, 2004). The second open access variant is publishing in peer-reviewed open access journals. The costs of open access publishing are borne by the author or author's institutional sponsor. Open access authors retain copyright, and grant permission to their articles through licenses such as the Creative Commons license. Articles in both open access variants may be indexed in search engines using the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH), which enables searching across multiple repositories.

In 1991 Ginsparg organized a preprint server, ArXiv, to distribute physics articles freely online. ArXiv was the first centralized open access archive of scientific articles. Scholars from other disciplines have also submitted preprint articles to the server, and it has grown to 470,000 articles and 16 mirrors on five continents (ArXiv, 2008a, 2008b). Since 2004, ArXiv has received over 3,000 submissions per month (ArXiv, 2008c). These articles, also called eprints, are generally not peer-reviewed, although authors may replace their original submissions with the final form of published articles accepted by peer-reviewed journals. An advantage of eprints is that they are circulated earlier than articles in traditional journals. Physics publishers have not reported a loss of revenue due to the ArXiv (Swan, 2005, p. 7). Schwarz and Kennicutt (2004, p. 7) note that the destination of many ArXiv eprints to peer-reviewed journals,

which have rigorous publication standards and editorial requirements, keeps the quality high.

Disciplines such as medicine have no preprint culture due to the potential liability of publishing inaccuracies. Researchers in these fields have sought the peer-reviewed open access journal alternative. The Public Library of Science and BioMed Central are examples of open access journal publishers. Some journals are hybrids, offering authors a choice of traditional or open access publication.

Large commercial publishers, who stood to lose profits, claimed that open access would destroy the peer review system, deprive authors of copyrights, exclude authors who could not afford to pay page charges, and bankrupt nonprofit publishers. But the peer review system, which is compatible with open access, continues to be rigorous. Authors retain copyright, and license permissions to open access publishers, repositories, and readers. Page charges may be paid by authors' sponsoring institutions or waived in case of authors' financial hardship.

The sustainability of business models for open access has not yet been established. Embargo periods and page charges to authors or sponsors vary with the cost of producing open access journals. It is uncertain what the effect of shifting journals funding from libraries to research institutions will be. Among the opposition to open access, the most compelling concern is that of traditional nonprofit scholarly publishers. Their journals tend to be high quality publications with low subscription prices, and their quality to cost ratios may be higher than commercial or open access publishers.

Studies have compared the research impact of open access and traditional journal

articles by using citation counts as a proxy for research impact. In 2004 McVeigh studied data from the Thomson ISI citation database and found that traditional journals still offered their authors more visibility than open access journals (pp. 5, 16). However, this study may have been premature because it used data from two years earlier when few open access journals existed, and search engine indexes of open access articles were incomplete. By contrast, Antelman (2004) found that open access articles across four disciplines had a greater research impact than articles not freely available. When comparisons were made between open access and non-open access articles within the same journal, studies showed that open access articles were cited two to three times as often as non-open access articles in the *Astrophysical Journal* (Schwarz and Kennicutt, 2004) and *Proceedings of the National Academy of Sciences* (Eysenbach, 2006).

Mandates for public access to publicly funded research. The results of research sponsored by taxpayers are often patented and copyrighted. This privatization of knowledge removes the benefit from the public who paid for it. To restore the investment to the people, legislators have tried to require public access to publicly funded research.

Congressman Martin Sabo, in 2003, proposed the first bill to mandate public access to the results of publicly funded research, titled the Public Access to Science Act (H.R. 2613). Mr. Sabo proposed to remove copyright protection from federally sponsored researchers, as is done to federal employees. The proposal sparked controversy, and the bill did not emerge from its congressional subcommittee.

Three weeks after a Harris Poll (2006) showed that 82% of U.S. adults were in

favor of making results of publicly funded research freely available online, Senators Cornyn and Lieberman introduced the Federal Research Public Access Act of 2006 (S. 2695), with the same purpose as Sabo's bill but leaving authors' copyrights intact. Even though it had bipartisan sponsorship, it suffered the same fate as the Sabo bill because of opposition from publishers.

A 2006 report of the European Commission recommended "public access to publicly funded research results shortly after publication" (recommendation A1, p. 11). In April 2007, the European Commission incorporated this open access mandate into its scientific grant application (Seventh Research Framework Programme, 2007). The Wellcome Trust (2008), a sponsor of medical research in the United Kingdom, has required grantees to deposit publications since October 1, 2006, into the permanent, open access archive PubMedCentral within six months of publication. The U.S. National Institutes of Health followed suit with an open access mandate (with a maximum of a one year embargo) effective April 7, 2008. The National Science Foundation has also resolved to make citations to research it funds publicly accessible online (NSF Office of Inspector General, 2006, p. 8).

Summary. Open information models provide users equitable access to a commonwealth of knowledge. Corrado (2005) states that the benefits to libraries of open source, open access, and open standards include increased access, lower costs, and better long-term preservation of scholarly works. Large commercial publishers and software corporations oppose open information models because they may lose profit. Due to steep increases in journals prices, scholars and librarians are switching to lower

cost and open access journals where possible.

Willinsky (2005) believes that by recognizing the similarities of different types of open initiatives, information stakeholders can unite to make information and technology accessible and economical. He asserts that using OSS to help in the operations of open access journals is a powerful combination. In order to prevent patent misuse, which may hinder scientific progress, scientists have also begun to consider how open source collaboration can be applied to the life sciences to share techniques and materials.

Current Research Findings and Gaps

Chudnov (1999) noted that libraries have not been quick to adopt OSS. Pace's (2005) and Breeding's (2007a) data on the number of sites per ILS vendor show that most ILSs in use are proprietary, and fewer than two percent of ILSs in use are open source. Few open source ILS products exist, they are not well known, and their software is not as mature and feature-rich as proprietary ILSs. By 2007 among public libraries in North America, only one state consortium (Georgia) of 265 libraries, two county library systems with about seven branches each (Athens County, OH, and Crawford County, PA), and four individual libraries were using open source ILSs.

Buchanan and Krasnoff (2005) observe that, in the school library environment, a completely open source solution might be impractical. Much educational software runs only on proprietary platforms, such as Windows or Mac OS. If an ILS were available only for an open source platform, this might necessitate purchase of new hardware, thus lessening any cost savings.

Most articles about library OSS are advocacy essays and many describe library applications other than ILSs. Clarke's (2000) master's thesis described the history of OSS in the library community, related the details of several library OSS projects and suggested that library OSS be studied further when it matures. Proffitt (2002) reported on the use of Koha at the Athens county library district in Ohio, and Cargile (2005) narrated her attempt to install an open source ILS. Among articles that are directed at librarians, Cargile observed a scarcity of practical information about OSS, such as simplified technical explanations.

A few articles describe empirical studies of open source ILSs. Kumar (2005) has compared the open source ILSs Koha, PhpMyLibrary, and OpenBiblio in a cross-comparison ranking of their features, and found that Koha was the most functionally mature of the three. Barbier (2005), Berizzi and Zweifel (2005), and Chalon, Alexandre-Joaquim, Naget, and Becquart (2006) recounted their decision-making processes in selecting an open source ILS as follows.

Barbier (2005) compared Koha with PhpMyBibli (PMB) on factors such as ease of installation and use, import and export of records, robustness, and security. Although he found PMB's interface more user-friendly, Barbier recommended Koha partly because it handled different MARC formats (MARC21 and UNIMARC). Barbier also questioned PMB's future as OSS because it is backed by a commercial firm. Berizzi and Zweifel (2005), and Chalon et al. (2006) researched several open source ILSs for small collections. After unsuccessfully trying to install Koha, both settled on PMB. Chalon et al. sought help in the forums and mailing lists. They felt that questions about installation,

hosting, and migration may go unanswered because of conflicts of interest with commercial open source firms that provide these services.

To choose an ILS for a group of libraries in the UK, Wilson (2005) surveyed 18 library staff and 4 patrons on three proprietary ILSs and one open source ILS. Many of the respondents tested all of the systems on the same day and were able to compare them directly. The respondents scored the ILSs on functional modules and common tasks. Respondents commented that Koha may have been "at a disadvantage because [it was] not presented as a sales pitch" and it was "Basic but functional. Clearly built to cost" (p. 5). Although Koha was rated lowest in every category behind FDI OLIB7, Sirsi Horizon, and Innovative Millennium, the group of libraries ultimately chose it. Lastly, a survey of approximately 1,000 Evergreen patrons (Georgia Public Library Service [GPLS], 2007) found that most respondents agreed or strongly agreed with positive statements about Evergreen, and many patrons found the Evergreen self-service features, such as placing online holds and renewals, easy to use.

Koha

Development of Koha, an open source ILS, began in 1999, funded by a group of libraries in rural New Zealand that found proprietary software expensive and lacking in needed features (Breeding, 2002; Proffitt, 2002). According to Blake (2000), Koha started out as a "rush job" to replace a system that wasn't Y2K compliant. The libraries licensed the ILS under the GNU GPL to make Koha freely available to other libraries and to avoid tying themselves to a particular software firm for maintenance.

Koha is written in the LAMP paradigm. Early adopters of Koha were

programmers who were in some way connected with libraries. Shortly after Koha was released for public download, developers who had independently written library software contributed new features to Koha. In 2002 only two school districts in North America were using it. A lack of compliance with interoperability standards limited the usefulness of the early open source ILS.

The first public library in the United States to use Koha was the Nelsonville Public Library, which serves Athens County, Ohio. They chose Koha because they were frustrated that they could not customize their proprietary ILS to their needs. The library financed the development of Koha's support for the MARC record format and Z39.50 information retrieval protocol. Z39.50 is an Internet communications protocol used in copy cataloging to search and transfer MARC records. This feature, which was more highly developed in proprietary ILSs, enabled interoperability with other systems, such as retrieving bibliographic catalog records from the Library of Congress. Henceforth, the added Z39.50 and MARC features and their source code were available to any library.

Koha went live in Athens County in 2003 in a district of seven library branches, 60,000 patrons, and a collection of 250,000 items (Hedges, 2003, 2005). The main library in Nelsonville spent several thousand dollars training staff in the MySQL database and programming languages PHP and Perl. The library director said the initial expenditure to add desired features was less than the annual fees of proprietary alternatives, "We may be spending $10,000 this year, but we will be saving $10,000 in license fees for every year thereafter" (Proffitt, 2002, p. 2).

The Koha source code shows that many different authors retain copyright to their programming contributions. Anyone may contribute to the code, but most development is currently done by a commercial open source firm begun by former employees of the Nelsonville library. The company, Liblime, has bought the Koha Web domain name, acquired the division of the New Zealand company that originated Koha, and hired employees from major proprietary ILS firms. An elected release manager who controls the software development is currently employed by Liblime. It is unknown whether the concentration of Koha resources in a company whose focus is "work for hire" rather than Koha is best for the Koha library community.

A turnkey system for Koha with technical support became commercially available in 2006, which could relieve libraries of installation and maintenance tasks. Koha has increased its scalability and performance by optimization for indexing (Liblime, 2005). Over 250 libraries worldwide use Koha (Breeding, 2007b; Koha Developer Wiki, 2007).

Evergreen

Evergreen is an open source ILS developed beginning in 2004 by a consortium of public libraries in Georgia. Currently the largest open source ILS, it was installed in 2006 in 252 libraries, increasing to 265 at the time of this survey. Scalability has not been a limitation of this ILS, which accommodates 1.8 million patrons and a collection of 9 million items (D. J. Very, personal communication, March 4, 2008). Evergreen uses clusters of Linux servers, an arrangement similar to that used by Google, which provide load balancing for performance, and redundancy for reliability (LaJeunesse,

2005). The underlying database is PostgreSQL (GPLS, 2006b), and the staff client software runs on Windows, with Linux and Mac support planned (LaJeunesse, 2006). Patrons access their accounts securely through a Web OPAC.

In the future, linkage with full-text article databases is planned (GPLS, 2006a). In 2007 the Michigan Libraries Consortium announced plans to install Evergreen (Michigan Evergreen, 2007). British Columbia, which installed Evergreen in three libraries, estimated the cost of the open source ILS as one fifth of a comparable proprietary ILS, a savings of $8 million Canadian dollars over the next five years (British Columbia Public Information Network for Electronic Services [BC PINES], 2007). Development is carried out by the Equinox company, started by former GPLS employees. Work on serials and acquisitions modules is being contributed by several Canadian universities.

Research Procedures

Survey Introduction

The purpose of this survey is to compare costs and benefits of open source and proprietary ILSs, and to find out the factors that influence a library's decision to adopt an open source ILS. To determine the ILS costs, questions were asked about annual cost, initial cost, and related cost of required system components. Questions about benefits took the form of satisfaction ratings on 5-point Likert scales. Additionally the questionnaire asked the reasons for ILS selection, whether the source code was customized, who provided system services, where the ILS was hosted, what problems were encountered, and library size and type.

The open source ILSs Koha and Evergreen were targeted in the survey. Other open source ILSs exist, but Koha and Evergreen were chosen for this survey because they had the largest user communities. At the time of this survey, which was conducted on October 30, 2007 to January 3, 2008, the current version of Koha was 2.2.9 and Evergreen was 1.2. The survey was answered by respondents using Koha (n=113), Evergreen (n=119), and proprietary ILSs (n=129). The survey respondents represent about 40% of known Koha libraries, and 30% of Evergreen libraries, but less than 1% of libraries using proprietary ILSs. The respondents were mainly librarians and IT personnel such as system administrators and computer programmers. About two each of the Koha respondents were consultants, students, or had installed Koha in home libraries.

Koha and proprietary ILS respondents answered the main questionnaire (see Appendix A). Evergreen respondents answered a subset of the questionnaire, which did

not include questions about ILS choice and administration. These questions were answered for Evergreen at the consortium level by the PINES program director because the selection, support, and costs were coordinated by the consortium.

Sample and Recruitment

A list of libraries using Koha was prepared from the Koha users list, Marshall Breeding's lib-web-cats database, email addresses in the archives of English and French Koha listservs, and Google searches of Koha OPAC URLs (inurl:opac-main.pl or inurl:opac-search.pl). This list contained email addresses of approximately 250 Koha library organizations, some of which had multiple branches. Many candidates for the Koha survey responded that they were unable to take the survey because they were still in the setup process, or had not used it very long.

The libraries using Evergreen are part of a voluntary consortium, PINES, in Georgia. Evergreen sample was prepared from a list of Georgia PINES libraries, the lib-web-cats database, and an internal Georgia PINES listserv. The total of Georgia PINES Evergreen (main and branch) libraries at the time of the survey was 265. Although several libraries in Canada had begun using Evergreen, they were not yet ready to be surveyed, as they had been using the software less than six months.

The respondents from libraries using proprietary ILSs were drawn from listservs. Several of the listservs had a particular library type focus: public, academic, special, or K–12 school libraries. Some of the listservs were international and others were mainly U.S.-based.

Recruitment of respondents was done by sending invitations to take the survey.

The letter to participants described the survey as a cost-benefit study of ILSs, but did not specifically mention the purpose of comparison between open source and proprietary systems. This was omitted to avoid exaggerated responses from participants who might wish to strongly promote one type of system over the other. The invitations, which were translated into French, Spanish, Italian, Portuguese, and Polish, were emailed to listservs and individual email addresses. The recruiting was voluntary and involved self-selection, and thus introduced some bias into the data which lessened the experiment validity.

The proprietary ILS respondents were recruited from listservs only; no individual recruitment emails were sent to them. Because answering a listserv post requires greater initiative than answering an individually addressed email, the self-selection bias is greater in the proprietary ILS sample. Self-selection can draw respondents with greater interest, knowledge, or stronger views, either positive or negative. One possible reason for the interest of some of the proprietary ILS users was their looking for a new ILS, mentioned by 12 respondents.

Another source of bias in the open source sample is clustering. The Evergreen users belonged to the same consortium, and some to the same libraries or regional systems. Eleven of the libraries using Koha had more than one respondent belonging to the same organization. Clustering may cause less variation in the results.

Survey Method

A limitation of this survey is that the benefits of the ILS, as given by satisfaction ratings, are subjective. Subjective ratings may reflect the rater more than the thing rated. For example, two respondents may report equal satisfaction with systems whose

functionality differs greatly. Another difficulty with soft data is that it may be reported differently by a respondent for the same question on different occasions. One question in this survey was asked twice in different parts of the survey. The answers were not exactly the same, but not significantly different.

Several other problems limited the effectiveness of the survey. A general problem with web surveys is the possibility of respondents' answering the survey more than once. Although the questionnaire was reviewed by several people, no pretest was done. The questionnaire was too long. The length of the questionnaire is a tradeoff between complete coverage of the topic and the time a respondent can spend on it. To avoid further lengthening, many terms in the survey were not defined, and the lack of definitions confused some respondents. For example, many respondents were unsure of whether their customizations were source code modifications, and thus a follow-up question was added for clarification. Also, respondents interpreted some terms differently depending on whether they were librarians or computer technologists. For example, *maintenance* was interpreted by a librarian to mean bibliographic cataloging, but interpreted by a system administrator to mean tasks such as file backup.

Although the survey was too long, lack of detail in the question text caused inconsistencies in the data. For instance, the library population may have been reported as the number of patrons who frequently use the library, whose names are registered in the ILS, or who live in the area. Also, the prerequisite system requirements cost may have been reported inconsistently: some respondents may have omitted the cost of hardware they already had. A possibly more accurate survey method is a telephone

survey, because it allows for immediate clarification and more consistent recording of data, but it is more expensive than a web survey.

Respondent Characteristics

If this survey experiment had perfect validity, no factor besides whether the ILS was open source or proprietary would affect the outcome. But the two main sample groups—open source and proprietary ILS libraries—differed on other characteristics. Tables 2–5 show characteristics of the open source and proprietary ILS respondents that might influence the survey outcomes.

The libraries using open source ILSs in this sample are mostly smaller than those using proprietary ILSs (Table 2). This is partly because Koha has not been tested in a large environment. The largest Koha installations answering this survey were two groups of 20 libraries each.

Table 2

Library Size

	Open Source								
	Koha			Evergreen[a]			Proprietary		
	n	mean	median	*n*	mean	median	*n*	mean	median
Library collection size	106	46,783	8,750	265	33,843	21,981	110	468,532	90,500
Library population size	104	5,823	520	265	6,945	2,910	112	260,764	14,500

[a] The Evergreen data for print volumes and registered patrons as of October 2007 were provided by Diana Very, Director of Statistics and Research, GPLS.

Table 3 shows the library types of the respondents. The libraries using Evergreen were all public libraries. Public libraries made up 30% of the proprietary ILS sample group, but only 12% of the Koha group.

Table 3

Library Type

Q 55) What type is your library?

		Open Source				
	Total	Sub total	Koha	Ever-green	Pro-prietary	Other /na
Total	365	232	113	119	129	4
	100.0	100.0	100.0	100.0	100.0	100.0
Public	172	133	14	119	39	
	47.1	57.3	12.4	100.0	30.2	
Academic	71	37	37		32	2
	19.5	15.9	32.7		24.8	50.0
Special	65	35	35		28	2
	17.8	15.1	31.0		21.7	50.0
School	27	17	17		10	
	7.4	7.3	15.0		7.8	
Home	2	2	2			
	0.5	0.9	1.8			
Don't know/no answer	28	8	8		20	
	7.7	3.4	7.1		15.5	

Table 4 shows the location of respondents by continent. The Evergreen respondents are all in Georgia, the proprietary ILS respondents are mainly in North America, and the Koha respondents are the most geographically dispersed. The proprietary ILS sample might least represent the proportions of type and geographic region in the actual population because of self-selection bias and the small sample size relative to the large total population of libraries using proprietary ILSs.

Table 4

Library Location

Q 56) Where is your library located?

		Open Source				
	Total	Sub total	Koha	Ever-green	Pro-prietary	Other /na
Total	365	232	113	119	129	4
	100.0	100.0	100.0	100.0	100.0	100.0
Africa	7	6	6		1	
	1.9	2.6	5.3		0.8	
Asia	20	11	11		6	3
	5.5	4.7	9.7		4.7	75.0
Europe	32	23	23		9	
	8.8	9.9	20.4		7.0	
North America	244	165	46	119	79	
	66.8	71.1	40.7	100.0	61.2	
Oceania	17	12	12		5	
	4.7	5.2	10.6		3.9	
South America	8	7	7		1	
	2.2	3.0	6.2		0.8	
Don't know/no answer	37	8	8		28	1
	10.1	3.4	7.1		21.7	25.0

As shown in Table 5, Koha libraries, more often than proprietary ILS libraries, tend to host their ILS (84% vs. 70%) and provide ILS-related services internally (61% vs. 31%). The Evergreen libraries of the Georgia PINES consortium host their systems inhouse and originally provided all services for their ILS internally. Subsequently, the employees who developed Evergreen formed a consulting company, now contracted by Georgia PINES to provide ILS services.

Table 5

ILS Hosting and Service Providers

	Koha (*n*=113)			Proprietary (*n*=129)		
	internal	external	both	internal	external	both
Hosting	84%	12%	-	70%	29%	-
Providers:	61%	22%	15%	31%	30%	35%
Installation	59%	29%	12%	43%	27%	27%
Documentation	57%	20%	14%	26%	38%	29%
Training	66%	17%	14%	37%	21%	40%
Support	58%	23%	18%	19%	38%	40%
Maintenance	66%	19%	16%	30%	28%	39%

OSS users are at liberty to customize any aspect of the software. Source code customization means changes written in a programming language such as Perl, but it does not mean configuring ILS options, changes to OPAC web page appearance made in HTML, or API scripts to access the catalog database. Libraries using Koha customize the source code (23%) more often than do libraries using proprietary ILSs (7%). Several of the proprietary ILS respondents reported source code customizations made by vendors at the library's request. A few respondents of both proprietary and Koha ILSs noted that their customizations were lost when the system was upgraded. The Evergreen ILS was created from scratch in Georgia, thus it could be considered completely customized, although individual PINES libraries must make requests through the consortium for further customization. One Evergreen respondent noted, "Almost every suggestion that 'really works' does seem to get integrated into the system eventually."

The differences in the characteristics of the sample groups temper the interpretation of the findings in the next section.

Findings

Reasons for ILS Choice

The Koha respondents in this survey based their choice of ILS on cost before functionality, whereas the proprietary ILS respondents reversed these priorities. Libraries using open source ILSs also cited customizability, freedom from vendor lock-in, and portability as reasons for choosing their ILS more often than libraries using proprietary ILSs. By contrast, libraries using proprietary ILSs more often cited ease of use, good technical support, trusted brand name, and having used the ILS before. This question was not asked of individual Evergreen libraries, but of only one representative of the Evergreen consortium.

Table 6

Top Five Reasons for ILS Choice

	Koha	Evergreen	Proprietary
1	Affordability	Scalability	Functionality
2	Functionality	Customizability	Affordability
3	Customizability	Security	Ease of use
4	Freedom from vendor lock-in	Technical support	Technical support
5	Ease of use	Ease of use	Trusted brand name

Among those who answered whether the selector had analyzed costs and benefits, 70% of open source respondents said they chose their ILS because it was the most cost-effective, compared with 46% of proprietary ILS respondents.

Eighteen respondents specifically mentioned open source as a reason for choosing their ILS. Seven open source respondents mentioned social and political reasons such as "to promote cooperative work," "a different way to spend public funds," and "to share with other institutions." Five reported mandates or strong support for

using open source at the organizational, regional, or national level. Two respondents said that long-distance technical support calls were difficult in remote regions with expensive and unreliable telephone networks; hence they chose open source or homemade systems. Nine proprietary respondents said their selection was based on a consortial decision, and five said their ILS was the result of an ILS company buyout more than a choice on the library's part. Two proprietary ILS respondents also mentioned that they were concerned about their vendors' future existence.

In the recruitment phase of the survey, about 30 candidates had seriously considered Koha but chose another solution. Twenty found Koha too complex for their needs or too difficult to install. Of these, three found inhouse solutions, five chose proprietary ILSs, and five chose smaller open source ILSs: PMB (two) and OpenBiblio (three). One person chose Emilda, another small open source ILS, and encountered a problem with very small OSS projects: the project is no longer supported by anyone. On the other hand, five candidates found Koha too small, lacking scalability, support, or an academic reserves module. Two were waiting for the next version of Koha to be released. One candidate had considered Evergreen but did not adopt it due to its lack of acquisitions and serials module, and uncertainty about whether the consulting firm had enough people to provide reliable 24/7 support.

ILS Satisfaction ratings

Respondents were asked to rate their satisfaction with their ILS on a 5-point Likert scale. Table B1 in Appendix B shows the average satisfaction ratings of various ILS aspects, the number of responses, difference of satisfaction ratings between the

sample groups (e.g., open source vs. proprietary), and two-tailed p-values for the differences. The table is sorted by the difference (t-statistic) of open source and proprietary ILSs from the comparatively higher-rated aspects of proprietary ILSs at the top to the lower-rated aspects of proprietary ILSs at the bottom. A few of the items were not rated by individual Evergreen libraries, but only at the consortium level. These items were installation smoothness, acceptableness of time to install, maintenance, scalability, and affordability.

Overall, the satisfaction of open source ILS respondents is slightly higher than that of proprietary ILS respondents (4.2 vs. 3.9 on a 5-point scale). The difference is statistically significant ($p < 5\%$, p-values are two-tailed throughout). However, it is uncertain whether the difference is due to the ILS being open source or proprietary, because the samples compared are different in terms of other population characteristics as shown in the Tables 2–5. This uncertainty also applies to interpreting the rest of the results in this survey where statistical significance is conjectured.

Installation smoothness, a question that was not asked of individual Evergreen libraries, was the category in which proprietary ILSs most exceeded the open source ILS Koha (3.7 vs. 2.9 on a 5-point scale, $p < 0.1\%$). Other categories in which proprietary ILSs exceeded open source ILSs, from highest to lowest difference, were documentation completeness ($p < 0.1\%$), acceptableness of installation time—not asked of individual Evergreen libraries ($p < 1\%$)—and original cataloging ease of use ($p < 5\%$).

At the opposite extreme, affordability, also not asked of individual Evergreen libraries, was the category in which Koha most exceeded proprietary ILSs (4.6 vs. 3.6 on

a 5-point Likert scale, $p < 0.1\%$). Other categories in which open source ILSs exceeded proprietary ILSs, from highest to lowest difference, were customizability, interoperability, portability ($p < 0.1\%$), functionality, OPAC completeness, scalability—not asked of individual Evergreen libraries, circulation/patron accounts ease of use ($p < 0.5\%$), OPAC self-service ease of use ($p < 1\%$), and overall ILS satisfaction ($p < 5\%$).

The results at the extremes coincide with the literature about open source and proprietary software. At one extreme, open source ILSs are thought to require more technical sophistication, and hence present a greater technical challenge to install. Documentation is also a commonly cited weakness of OSS. At the other extreme, open source ILS respondents are more satisfied than proprietary ILS respondents with the affordability and customizability of their systems.

However, as the statistical significance of the difference between open source and proprietary ILS ratings decreases, some of the other results contradict the literature. It was unexpected that open source users would rate their satisfaction with functionality, OPAC completeness, scalability, or ease of use as higher than would proprietary ILS users.

Three observations can be made about the satisfaction ratings in Table B1. First, the most extreme differences were in categories where essentially the only open source respondents who were asked the questions were Koha users, because installation and decisions about affordability for Evergreen were handled at the consortium level. Are these results peculiar to Koha, or inherent to all open source ILSs? If Evergreen is

installed in more libraries in the future, more data could be gathered from Evergreen users to gain insight. Secondly, the proprietary ILSs were rated higher on cataloging items, while the open source ILSs were rated higher on OPAC items. Perhaps this reflects that the proprietary ILSs programmers have more bibliographic cataloging expertise. Third, the highest rated strengths of OSS are more conceptual (affordability, customizability, interoperability, portability, functionality), while the highest rated strengths of proprietary ILSs are more concrete (installation smoothness, documentation completeness, satisfaction with installation time, cataloging ease of use).

Verbatim comments from respondents reflect the numeric ratings. While the open source ILS respondents' comments about installation and documentation were occasionally positive, many expressed the need for improvement. Regarding documentation for open source ILSs, Koha respondents said, "The documentation is not updated regularly," and, "Certain sections are very complete, whereas others are incomplete or missing. Plus, depending upon what computer, software version, etc., you are using, some of the documentation does not match." One Evergreen librarian was not able to understand the "programming jargon." Some respondents had suggestions for improving the open source ILS documentation:

- The documentation could be more user-friendly.
- It should have more screenshots and be easier to understand, using plain language.
- Needs more attention to getting Z39.50 servers installed and working.
- Needs ... language the end user can understand.
- More practical details.
- Better documentation about MARC fields and setting up parameters.

A preference for documentation written by librarians was expressed by three

respondents, "The documentation supplied is written by the developers, but ideally should be written by users (librarians)." A librarian agreed about writing a manual, "We need to come forward to do things for [ourselves]," and another added, "As more librarians use the software, the documentation is getting better." Six open source respondents said they had or planned to contribute to the documentation. One also mentioned attempts to bring all Koha documentation into a central Web location. Another respondent preferred a printed manual. Elizabeth Garcia, the PINES program director, said the Georgia PINES consortium was getting a grant to write more documentation for the Evergreen ILS.

Koha respondents expressed difficulties with installation. Respondents said, "Installation took an inordinate amount of time because of the trial and error of trying to install on various operating systems..., hardware and software incompatibilities, etc," "Too many Perl modules that needed to be downloaded separately," "It took us two and a half more days to get it to access external Z39.50 servers," and "It is not an out-of-the-box solution." Four respondents felt that Koha installation smoothness was improving with time. Three expressed the need for a bundled installer, which would contain all components and automate the configuration.

ILS Problems

Respondents were asked about problems with ILS modules, data loss, lapses in service, and security breaches. The users of Koha and proprietary ILSs reported no significant difference in these types of problems. In an "other write-in" category, six Koha users mentioned difficulties with the Z39.50 function, which downloads catalog

records. The number of problems that Evergreen users attributed to the ILS itself was not significantly different than that of proprietary ILS users. However, when combining the problems due to the Evergreen ILS with problems possibly due to another source such as network outages, the difference was significant ($p < 0.1\%$). Evergreen users also had significantly more lapses in service ($p < 0.1\%$), problems with the circulation module ($p < 0.1\%$), and problems with the OPAC/search engine ($p < 0.5\%$). This may be due to the recent release of Evergreen, which went live in September 2006, only 15 months before the survey was conducted. By comparison, the users of proprietary ILSs were using mature software. Eighteen of the proprietary ILS users made reference to the age of their ILS or said they had weathered ILS company mergers.

Eight Evergreen respondents related the ILS problems to its being relatively new and still improving. One respondent said that most of the problems were due to the "software being new and a work in progress," and another said Evergreen was "undeniably launched prematurely—every staff member became an alpha tester in effect the first few months." It may have been premature to survey Evergreen users at this time, and perhaps in a few years the Evergreen problems will decrease. Nine Evergreen respondents mentioned slow response time of the system. One explained, "There are many times a day that we have slowness in doing many functions at the circulation desk and in the cataloging department." Attempts to resolve the ILS slowness have included adding more T1 network hardware to increase bandwidth and raising the priority of ILS traffic on the network.

ILS Costs

Evergreen costs. Before Evergreen, the Georgia PINES consortium used the Unicorn ILS made by vendor SirsiDynix, running on a Sun Microsystems server. The previous costs are shown in Table 7. The old server cost one million dollars initially, and the annual cost was $558,000:

Table 7

Annual Cost of Previous ILS at Georgia PINES Consortium

Item	Cost
• Hardware	
Sun Microsystems maintenance	$56,000
Server/networking costs	$102,000
• Software (ILS)	
License fees	$200,000
Service/maintenance	$200,000
Total annual cost of previous ILS	$558,000

The cost and library size questions about the current Evergreen ILS (Table 8) were not asked of the individual Evergreen libraries, but rather asked only at the state consortium level. Data for print volumes and registered patrons as of October 2007 were provided by Diana Very, Director of Statistics and Research, GPLS. The Evergreen cost questions were answered by Elizabeth Garcia, PINES program director, in a phone interview in January 2008.

Table 8

Evergreen Size and Costs at Georgia PINES Consortium

Size or Cost	Amount	Units
Collection size	8,968,482	print volumes
Service population	1,840,318	registered patrons
Consortium size	265	libraries
Prerequisite system requirements	$150,000	
Annual cost	$450,000	
Initial labor cost	$252,500	

All residents of Georgia, population 9 million, may check out books from the PINES consortium. The libraries in the Atlanta metropolitan area, which has about half the state's population, do not belong to the consortium or use the Evergreen ILS. However, their residents may check out PINES items.

The current cost of $150,000 for prerequisite system hardware of the Evergreen system includes commodity hardware, networking equipment, and redundant power. The individual Georgia PINES libraries did not need new hardware to use Evergreen. The initial (software) materials cost was nothing: all components were OSS. The initial labor cost of $252,500 consists of:

- $ 15,000 outsourced programming
- $ 10,000 employee training and travel
- $227,500 staff programming ($130,000/year for 1.75 years)

Ms. Garcia reported that the flexibility of OSS to run on commodity hardware gives them a great cost savings. When any hardware component fails, the system administrators can search for the lowest cost replacement, rather than being tied to an expensive server.

The current annual cost of $450,000 for Evergreen at Georgia PINES includes $350,000 for ILS costs to the Equinox service company and $100,000 for networking costs. The networking equipment is also used for other non-ILS library functions such as staff email. The savings over the previous proprietary ILS is more than $100,000 annually.

ILS costs estimated by vendors. To estimate proprietary ILS costs, several vendors in the United States were contacted for price quotes for a library of 15,000 items. After removing the highest and lowest estimates, four quotes for initial costs and three quotes for annual costs were obtained. Some of the estimates did not include acquisitions or serials modules, or hardware. The mean initial cost was $24,313 and the mean annual cost was $2,133. Costs may be higher for additional branch libraries. Two quotes for Application Service Providers (ASPs, which are hosted by the vendor) conformed to the normal ASP pattern of lower initial cost and higher annual cost. One vendor representative said that the high price was partly due to the cost of the Oracle database license.

The survey data for proprietary ILSs were lower: for this library size category (10,000 to 25,000 collection items) the mean prerequisite cost was $4,594 ($n$=8), initial cost was $9,700 ($n$=5), and the annual cost was $3,200 ($n$=10). An exact comparison with the vendors' quotes is difficult due to the small number of data points and the differences between the quotes and survey data on vendors, ILS functionality, and geographic regions. However, given that several of the proprietary ILS respondents had installed their systems years ago, the price difference might indicate that initial costs of

proprietary ILSs are currently higher than reported in this survey.

A Koha consulting firm in the United States estimated the cost for a library of 15,000 items at $10,700 including hardware and the first year of support. Thereafter, the annual support cost would be $2,500. A lower initial cost for an ASP setup was estimated at $6,150 with daytime-only support, not including training. Full 24/7 support and training raised the ASP price to $10,250. The comparable survey data for Koha in this size category are prerequisite cost of $3,382 ($n$=17), initial cost of $3,859 ($n$=16), and annual cost of $1,429 ($n$=14).

Comparison of open source and proprietary ILS costs. The cost questions asked by this survey were prerequisite system requirements (Table B2), initial cost (Table B3), and annual cost (Table B4). The initial cost was further broken into materials (Table B5) and labor (Table B6). The most important of the costs is annual cost. The initial costs are one-time costs, and the prerequisite costs are influenced but not completely determined by the ILS. Respondents were asked to give answers in terms of cost ranges. The Tables B2–B6 were computed using the midpoints of these cost ranges, which are imprecise. The figures are given in U.S. dollars.

The cost questions were not asked of individual Evergreen libraries. The reported costs for Evergreen libraries were derived by dividing the total consortium costs by the number of libraries (265) in the Georgia PINES consortium. These figures represent average costs for individual Evergreen libraries.

ILS cost is affected by library size. The ILS costs of large libraries are more than those of small libraries. Among those surveyed, the libraries using open source ILSs

were on average smaller than those using proprietary ILSs. To control for library size in Tables B2–B6, the cost data are displayed by library size ranges. The costs of ILSs are compared within like-sized libraries. Because of the breakdown into smaller subsamples, most of the differences within the size categories are statistically insignificant.

The figures for initial materials cost (Table B5) are imprecise because no option for zero cost was offered in the questionnaire. However, the initial materials cost of most open source ILSs is zero. The lowest cost range in the questionnaire was $0 to $500 USD. Therefore, the initial materials costs of Koha might actually be as much as $250 lower than displayed in Table B5.

Except for initial labor cost (Table B6), the average costs of open source ILSs are less than proprietary ILSs in almost all cost and size categories. Three data points of low-cost proprietary ILSs for small collections fell outside this pattern and cost less than their open source counterparts. The higher initial labor costs of open source ILSs in some categories corroborate the view that OSS requires greater technical sophistication to use than proprietary software.

Let us consider alternative explanations for the cost findings. Koha libraries in this survey are found in greater numbers in lower income countries than are libraries using proprietary ILSs (29% vs. 11%). The lower labor rates in rural areas and developing countries might cause the Koha costs to appear lower. To control, albeit crudely, for diverse labor rates of geographic regions, the cost data were filtered on whether the gross national income per capita of the respondent's country was over or under $25,000 USD.

With this filter, the results were somewhat less clear. Comparing within like categories of library size and regional income, some proprietary ILSs cost on average less than Koha on system prerequisites and initial costs, although the difference was statistically insignificant. This regional income filter did not change the outcome of annual cost and initial labor cost comparisons: the annual costs of Koha are lower than those of proprietary ILSs, but the initial labor costs of Koha are sometimes higher.

The costs reported in this survey might be inaccurate for several reasons. The wording of the question on initial costs was not specific: respondents might or might not have included costs of migration and customization. Currency conversion to U.S. dollars may have been inaccurate partly due to fluctuating exchange rates. Also, the question text on labor costs did not mention internal costs such as staff salaries. Thus respondents may have omitted internal costs, and this omission might have disproportionately underreported Koha costs, because more open source ILS libraries provide ILS services internally. One respondent said, "Koha is the most cost-effective as far as outlay of money, but the time that it required of me does have a cost that isn't always factored in. On the other hand, ... my new knowledge has a benefit for the school district that I work for."

Other characteristics of the sample groups may affect the costs. For example, the cost per individual Evergreen library is low in part due to the economy of scale achieved by the consortium. Also, libraries with open source ILSs might be using more volunteer time to work on them than libraries with proprietary ILSs, and therefore might underreport the costs of open source ILSs. On the other hand, more libraries using open

source customized their ILS, which may have raised their costs. The libraries using proprietary ILSs may have reported lower costs because their ILSs were purchased several years ago (n=18), or because of their membership in consortia (n=13).

A proprietary ILS respondent suggested one of the reasons for the high costs of proprietary ILSs is the use of proprietary databases: "Commercial ILS vendors have also become 'married' to relational database vendors such as Oracle to provide back-end solutions to their products. This will result in a continued escalation in costs and will bring into question sustainability for many libraries."

Summary of the Findings

The survey asked libraries about their ILS: the reasons for choosing it, satisfaction, problems, and costs. The main reasons given by libraries for choosing Koha, Evergreen, and proprietary ILSs were affordability, scalability, and functionality, respectively. Libraries using open source ILSs more often chose their ILS on the basis of cost-effectiveness than did libraries using proprietary ILSs. Of libraries that considered Koha but did not choose it, two thirds found it too complex or difficult to install, and others found it lacked functionality.

The survey respondents rated their satisfaction with various aspects of their ILS. Libraries using open source ILSs reported slightly higher overall satisfaction than did libraries using proprietary ILSs. Koha most exceeded proprietary ILSs in affordability, but proprietary ILSs most surpassed Koha on installation smoothness. Users of both Koha and Evergreen were significantly more satisfied than users of proprietary ILSs with the customizability of their system, but far less satisfied with its documentation

completeness.

Besides installation and documentation issues, Koha and proprietary ILSs did not differ significantly on other problems. However, in its first 15 months of use, Evergreen had more problems, likely due to its newness, whereas the proprietary ILSs with which it was compared were older, some by more than 10 years. In this regard it was premature to survey the users of Evergreen.

Taking library size into account, open source ILSs cost less on average than proprietary ILSs, except for some initial labor costs. A higher proportion of Koha libraries were found in countries with lower labor rates. Dividing the data into high and low income subsamples by national per capita income, some cases were found in which proprietary ILSs cost less than Koha. Due to small subsample sizes, the differences were statistically insignificant. The annual cost of Koha was still consistently lower than proprietary ILSs, taking library size and regional labor rates into account.

The consortium of libraries using Evergreen saved $100,000 annually over its previous ILS. A great deal of this savings was because OSS can be used with commodity hardware. The ILS costs were low compared with the other libraries in this survey also for a reason unrelated to open source: the economy of scale reaped by 265 cooperating libraries.

Conclusion

Alternative Explanations and Limitations of the Study

This study sought to understand differences between libraries using open source and proprietary ILSs. However, because the two sample groups were not otherwise identical, differences in the results might not be solely due to whether or not the ILS was open source, but due to differences in other sample characteristics such as library size, type, location, ILS functionality, whether the ILS was customized, and who provided services for it. Also, the sample selection procedures for the two sample groups were different. All participants were recruited by survey invitations posted to listservs, but open source participants additionally received an individual email.

Some of the differences in the characteristics of the libraries were as follows. The libraries using open source ILSs in this survey were smaller on average than libraries using proprietary ILSs. The open source libraries more often hosted their ILS and provided services internally. The libraries using Evergreen were all public libraries, part of a consortium in Georgia. By contrast, the libraries using Koha were the most geographically diverse, located internationally. In this sample, only 12% of libraries using Koha were public libraries, compared with 30% of libraries using proprietary ILSs.

These underlying differences in the sample groups may compromise the validity of the results. For example, the higher proportion of services provided internally by library staff for open source ILSs might raise the satisfaction ratings of open source ILSs because of library staff members' personal investment in the ILS. To control for some of these variables, the cost and satisfaction tables were filtered by whether the ILS was

customized, where it was hosted, and who provided ILS services. However, no patterns or logical connections emerged. The subsample sizes were often too small to be statistically significant for these tests.

Respondents who felt open source ILSs were a more ethical choice might have rated them higher for ideological reasons rather than practical ones. Also, in the satisfaction ratings, open source ILS respondents' expectations may have been tempered by paying lower costs.

The study also had other limitations, which must be taken into account. It did not compare the ILSs on functionality, other than to ask whether the ILS had modules such as circulation or serials. Survey respondents reported on their library's ILS and did not examine other ILSs in direct comparison as respondents in Wilson's (2005) study did. The respondents in the present survey were mainly library employees; library patrons' opinions of the usability of the ILS were not included as they were in the GPLS (2007) survey. Benefits of the ILS were expressed as satisfaction ratings, which are subjective. The wording of the questionnaire may have not been detailed enough to yield accurate answers, especially in the questions on costs.

Recommendations for Future Research

The length of the survey was a tradeoff between complete coverage of an ILS and attention span of a respondent. Splitting the survey into shorter questionnaires would allow more detailed questions and greater accuracy in answers, while keeping the length manageable.

To give a clearer picture of an ILS, these questions could be added:

- When was the ILS first installed? Last upgraded?
- What is the current version number of the ILS?
- Is your ILS the one you originally chose, or has your vendor substituted a different one due to obsolescence or vendor buyout?

A future survey could also include questions to determine if progress has been made on the weaknesses of open source ILSs found in the present survey, such as installation, documentation, and the Koha Z39.50 module.

The validity of the survey could be increased by eliminating extraneous factors where possible. For instance, narrowing the time span of the questions to the current version of the software would make the comparisons between open source and proprietary ILSs more equal. Excluding the migration from questions about installation time and cost would increase the focus on the current ILS, because migration depends on the previous ILS and the cleanliness of the ILS data.

Improvements to the cost questions could include asking for customization costs separately and reminding respondents to include internal staff costs for ILS-related services. Clearer definitions of library collection size and population size may yield more accurate data. Conducting the survey by telephone rather than on the Web might increase the accuracy of responses, but would be more expensive.

As more libraries adopt Evergreen, it would be interesting to survey them. Apart from this survey format, it would also be interesting to investigate the costs of other large consortia with shared catalogs, in order to compare them with the Georgia PINES consortium. Comparing Koha with Evergreen was not a goal of this study. However, in

the future, if Koha could scale up and Evergreen could scale down, so that enough similarly sized libraries using them could be surveyed, a comparison might be useful.

Implications for Future Practice

The survey results suggest that open source ILSs need smoother installation processes and complete documentation. Many respondents encountered parts of the open source systems that did not work. These issues are significant barriers to adoption of open source ILSs. Improving these aspects could lower the barrier to their use. Lack of documentation creates duplication of effort as users encounter the same issues and independently reinvent solutions. There is no inherent reason why an ILS should be more difficult to install than an operating system. Open source projects with larger user and developer bases have been shown to produce higher quality software that is more functional and beneficial to their communities. Therefore, remedying these issues will benefit the library community by expanding the user population, who can in turn contribute feedback, testing, documentation, bug fixes, and code to the ILS.

In the future, it should be possible to create a subset of Evergreen for use in small libraries. Also, an automated installer that combines the components of Koha was suggested by several respondents. This would help to eliminate mismatched components and reduce human error during installation. For small libraries, an ILS that can coexist with other software on the same machine would save the cost of having to buy another computer. It is reasonable to hope that installing an open source ILS would be as smooth and bug-free as installing the LAMP components, which can be done by a system administrator without debugging. The library community should not expect less.

One respondent suggested, "Koha should be guided by an international forum combining librarians, library school teachers and computer professionals." The open source ILSs Koha and Evergreen were begun with public funds at public libraries, and continued development is sponsored by public and nonprofit libraries and universities. Volunteers also contribute to the projects. However, commercial firms currently control the development of these open source ILSs.

This arrangement might not be in the best interest of the library community because the priorities of for profit companies are often to pursue the highest-paying clients. Their priorities may be different than those of the library and open source community, whose goals are sharing information and technology. The difficulties of installation and lack of documentation may profit commercial open source firms by perpetuating dependence on them.

Therefore, this study recommends the creation of a nonprofit foundation for open source ILSs. Such a foundation could promote the principles of libraries and open source, prioritize development based on users' needs, and lower the technical barriers to use for small, independent libraries. Several such foundations have been set up for other open source projects (e.g., Apache, Linux, Perl) to coordinate resources and advocate for their communities.

Discussion

Libraries chose the open source ILS Koha primarily because it was affordable, and secondarily because it was functional, customizable, and free from vendor lock-in. Several respondents chose it because it was open source. Some of this group felt it was

an ethical choice to "share with other institutions" and "promote cooperative work."

Strengths and weaknesses of OSS commonly cited in the library and open source literature are confirmed by the survey. Respondents found open source ILSs more affordable and customizable than proprietary ILSs, but neither as easy to install nor as well documented. The total cost of an open source ILS, taking into account both initial and perpetual costs, was on average less than that of a proprietary ILS. However, the initial cost of labor to install an open source ILS was often higher than that of a proprietary ILS. The word *free* in *free software* thus means *having liberty* to view the source code, rather than *having no cost.*

Vendors of proprietary software have criticized OSS, but this criticism is challenged by the surprising finding that libraries using open source ILSs are actually a bit more satisfied overall than libraries using proprietary ILSs, although they pay less for them. The hypothesis of this study is that open source ILSs are more cost-effective than proprietary ILSs. This is true for libraries that have been able to develop or debug an open source ILS, or engage a consultant to do so. Their satisfaction is slightly higher and their costs are lower. However, considering the limitations of this study—that effectiveness was measured as user satisfaction rather than functionality, and that the wording of cost questions may not have given rise to accurate answers—further research is needed.

Libraries that have technical staff persons but few additional funds for computing stand most to benefit from an open source ILS. How much technical expertise is needed by libraries in order to use an open source ILS? The goal might simply be one of system

administration, which involves installing and maintaining hardware and software. This requires following detailed instructions, but not programming logic. If libraries take responsibility and initiative to provide basic technical skills, open source ILS developers could meet them halfway with software that installs smoothly without requiring programming and debugging to use.

At the time of this survey, open source ILSs are still works in progress. For example, the Z39.50 copy cataloging module of the current stable version (2.2.9) of Koha is not working without debugging, as several respondents noted. This is an impediment even for experienced system administrators. The incomplete Koha documentation in the online manual does not cover basics—for example, how to delete a catalog record. As for Evergreen, which runs on clusters of servers, reports of installing it in small environments or on a single server are few (LaJeunesse, 2008; Scott, 2008). Theoretically, there is no reason why an ILS such as Koha should be more difficult to install than an operating system, nor is there a reason why Evergreen cannot be scaled down to a small library. These systems might reach their theoretical promise in the future. However, their development might not be rapid, partly because it is currently controlled by commercial open source companies whose focus is revenue, rather than the library community.

The open source library community might be better served by electing a project leader and release manager from a user group, rather than from a commercial firm whose interests might conflict with the community. Librarians might form a nonprofit foundation to keep the development of open source ILSs focused on public service goals.

The tasks would be maintaining the scalability and advanced features appropriate to large libraries and consortia, without neglecting the basics of quality, documentation, and ease of installation needed by all libraries, including small, independent ones. This might provide the development of open source ILSs with a democratic balance.

Summary

An open source ILS is a potentially functional, affordable tool. It is particularly appropriate for libraries because librarians and OSS developers share values of freedom of information and equal access, and serve their communities by providing materials economically. This survey found that libraries using open source ILSs choose them mainly for affordability, and that open source ILSs cost less than proprietary ones. Users of open source ILS are modestly more satisfied than users of proprietary ILSs. However, according to this survey, the Koha ILS in its present form lags furthest behind proprietary ILSs in installation smoothness. Also, the two major open source ILSs, Koha and Evergreen, compare unfavorably with proprietary ILSs in documentation completeness.

The early architect of free software, Richard Stallman, compared free software to public radio, which benefits all users regardless of their ability to pay (2002, p. 59). Has the potential of an open source ILS been reached? Not yet, for technical and, possibly, organizational reasons. The technical issues of installation, documentation, and software quality are yet to be resolved. A recommendation of this study is to focus future development efforts on alleviating these defects, in order to lower technical barriers to the use of open source ILSs. Organizationally, open source ILS projects might be best

coordinated by a nonprofit entity. Improving these technical and organizational aspects of open source ILSs might bring open source software closer to its full potential for libraries.

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Appendix A: Survey Questionnaire[1]

Introduction

1. Which ILS does your library use?

2. How would you rate your satisfaction with your ILS overall?

1 – very dissatisfied	2 – somewhat dissatisfied	3 – neither satisfied nor dissatisfied	4 – somewhat satisfied	5 – very satisfied	don't know/ no answer

3*. Before your ILS was selected, did the selector(s) analyze costs and benefits of ILS alternatives?

- Yes, this ILS was selected as most cost-effective.
- No.
- Don't know/no answer
- Yes, but this ILS was selected for other reasons (What reasons? Please specify.)

4*. Please rank in order the top 5 reasons your library chose this ILS. Choose "1" for most important, "2" for second most important, etc.

- security
- combined with other incentives
- desirable features/functionality
- trusted brand name
- affordable price
- good technical support
- portability
- ease of use
- customizability
- we used this ILS or vendor before
- freedom from vendor lock-in
- scalability
- other (please specify and rate as 1 - 5)
- don't know/no answer

[1] Questions marked with an asterisk (*) were not asked of individual Evergreen libraries, but were asked of the Evergreen consortium director, and all other respondents.

5. How would you rate your satisfaction with your ILS on the following items?

1 – very dissatisfied	2 – somewhat dissatisfied	3 – neither satisfied nor dissatisfied	4 – somewhat satisfied	5 – very satisfied	don't know/ no answer

- portability
- scalability*
- ease of use
- affordability*
- customizability
- features/functionality
- technical support
- security
- interoperability

6*. Is your ILS hosted on site at your institution or off site?

on site/parent site off site/service provider don't know/no answer

7*. Who provides the following items for your library's ILS?

internal staff external contractor both don't know/no answer

- Installation
- Documentation
- Training
- Support
- Maintenance

Customization[2]

8*. Has your library customized (or sponsored customization of) the ILS source code?

yes no don't know/no answer

9*. Were your customizations

A) limited to modifying the appearance of web pages (in HTML or CSS) such as to show your library name, logo, etc, or to configuring ILS options such as branch libraries and circulation policies,

[2] Customization questions 9 and 10 were asked as an email follow-up for Koha respondents.

B) or did your customizations involve changing the source code (in Perl, PHP, or another programming language)

C) or something else?

D) don't know/no answer

10*. Can you please briefly describe your customization?

Installation

The process of ILS installation includes configuration of ILS catalog format and circulation policies, and migration or data entry of the catalog and user accounts.

11*. Were you involved in the installation of your ILS, either directly (installing it yourself) or indirectly (having others install it)?

yes no

12*. How smoothly did the installation of your ILS go? (The process of ILS installation includes configuration of ILS catalog format and circulation policies, and migration or data entry of the catalog and user accounts.)

1 – with extreme difficulty	2 – with some difficulty	3 – neither smoothly nor with difficulty	4 – somewhat smoothly	5 – extremely smoothly	don't know/no answer

13*. Approximately how long did it take to install and configure the ILS, including catalog and user account migration? Please enter the approximate number of days.

14*. How acceptable to you was the amount of time it took to install the ILS?

1 – very unacceptable	2 – somewhat unacceptable	3 – neither acceptable nor unacceptable	4 – somewhat acceptable	5 – very acceptable	don't know/no answer

15*. Do you have any comments about the ILS installation process or how it could be improved?

OPAC

16. The Online Public Access Catalog (OPAC) contains a search engine to the catalog. Are you familiar with your ILS's OPAC?

yes no

17. Regarding the ILS's OPAC search engine, how would you rate its ease of use?

1 - very hard to use	2 - somewhat hard to use	3 - neither easy nor hard	4 - somewhat easy to use	5 - very easy to use	don't know/no answer

18. How would you rate the OPAC search engine's completeness of features?

1 - lacks all features we need	2 - lacks most features we need	3 - has some but lacks some	4 - has most features we need	5 - has all features we need	don't know/no answer

19. What is your perception of how easy it is for patrons to make self-service requests online for renewals and holds?

1 - very hard	2 - somewhat hard	3 - neither easy nor hard	4 - somewhat easy	5 - very easy	don't know/ no answer

Circulation and Patron Accounts

The following questions are about your daily experience using your library's ILS.

20. The circulation and patron accounts modules may be used to process book loans, returns, renewals, holds, to enter new patron accounts, resolve fines, or edit patron information. Are you familiar with your ILS's circulation and patron accounts modules?

- Yes.
- No, I use them on average less than two hours per week.
- No, our ILS does not have circulation and patron accounts modules.*
- No, our library is noncirculating.*

21. How would you rate the ease of use of the circulation and patron accounts modules?

1 - very hard to use	2 - somewhat hard to use	3 - neither easy nor hard	4 - somewhat easy to use	5 - very easy to use	don't know/no answer

22. How would you rate the completeness of features of the circulation and patron accounts modules?

1 - lacks all features we need	2 - lacks most features we need	3 - has some but lacks some	4 - has most features we need	5 - has all features we need	don't know/no answer

23. How easy is it for staff to process loans and returns in the ILS?

1 - very hard	2 - somewhat hard	3 - neither easy nor hard	4 - somewhat easy	5 - very easy	don't know/ no answer

24. How easy is it for staff to process requests for renewals and holds in the ILS?

1 - very hard	2 - somewhat hard	3 - neither easy nor hard	4 - somewhat easy	5 - very easy	don't know/ no answer

25. How easy is it for staff to do tasks such as adding a new patron account, resolving a fine, or updating a patron's address in the ILS?

1 - very hard	2 - somewhat hard	3 - neither easy nor hard	4 - somewhat easy	5 - very easy	don't know/ no answer

Cataloging

26. Are you familiar with your ILS's cataloging module?

- Yes.
- No, I use it on average less than two hours per week.
- No, our ILS does not have a cataloging module.*

27. How would you rate the ease of use of the cataloging module?

1 - very hard to use	2 - somewhat hard to use	3 - neither easy nor hard	4 - somewhat easy to use	5 - very easy to use	don't know/no answer

28. How would you rate the completeness of features of the cataloging module?

1 - lacks all features we need	2 - lacks most features we need	3 - has some but lacks some	4 - has most features we need	5 - has all features we need	don't know/no answer

29. How easy is it to add original catalog records from scratch in the ILS?

1 - very hard	2 - somewhat hard	3 - neither easy nor hard	4 - somewhat easy	5 - very easy	don't know/ no answer

30. How easy is it to do copy cataloging in the ILS, that is, to do tasks such as retrieving catalog records from OCLC or Library of Congress and adding local holdings information?

1 - very hard	2 - somewhat hard	3 - neither easy nor hard	4 - somewhat easy	5 - very easy	don't know/ no answer

Serials

31*. The serials module may be used to manage journal or magazine subscriptions. Are you familiar with your ILS's serials module?

- Yes.
- No, I use it on average less than two hours per week.
- No, our ILS does not have a serials module.

32*. How would you rate the ease of use of the serials module?

1 - very hard to use	2 - somewhat hard to use	3 - neither easy nor hard	4 - somewhat easy to use	5 - very easy to use	don't know/no answer

33*. How would you rate the completeness of features of the serials module?

1 - lacks all features we need	2 - lacks most features we need	3 - has some but lacks some	4 - has most features we need	5 - has all features we need	don't know/no answer

Acquisitions

34*. The acquisitions module may be used to manage book or materials orders. Are you familiar with your ILS's acquisitions module?

- Yes.
- No, I use it on average less than two hours per week.
- No, our ILS does not have an acquisitions module.

35*. How would you rate the ease of use of the acquisitions module?

1 - very hard to use	2 - somewhat hard to use	3 - neither easy nor hard	4 - somewhat easy to use	5 – very easy to use	don't know/no answer

36*. How would you rate the completeness of features of the acquisitions module?

1 - lacks all features we need	2 - lacks most features we need	3 - has some but lacks some	4 - has most features we need	5 – has all features we need	don't know/no answer

Documentation

37. ILS documentation may include manuals, documents, or help menus in your ILS. Have you read any of your ILS documentation?

yes no

38. How would you rate your satisfaction with your ILS documentation (which may include manuals, documents, or help menus)?

1 – very dissatisfied	2 – somewhat dissatisfied	3 – neither satisfied nor dissatisfied	4 – somewhat satisfied	5 – very satisfied	don't know/ no answer

39. How would you rate the completeness of your ILS documentation?

1 - very incomplete	2 - somewhat incomplete	3 - neither complete nor incomplete	4 - somewhat complete	5 - very complete	don't know/ no answer

40. Do you have any comments about the documentation or how it could be improved?

Support, Maintenance, and Reliability

41. *Support* refers to the help you need when you are troubleshooting or seeking clarification on how to use a feature that is new to you. How would you rate your satisfaction with your ILS support?

1 – very dissatisfied	2 – somewhat dissatisfied	3 – neither satisfied nor dissatisfied	4 – somewhat satisfied	5 – very satisfied	have not received support

42. Do you have any comments about your ILS support or how the support could be improved?

43*. *Maintenance* refers to periodic backups, patches, and upgrades. How would you rate your satisfaction with your ILS maintenance?

1 – very dissatisfied	2 – somewhat dissatisfied	3 – neither satisfied nor dissatisfied	4 – somewhat satisfied	5 – very satisfied	don't know/ no answer

44. How would you rate your satisfaction with your ILS in terms of reliable, trouble-free operation?

1 – very dissatisfied	2 – somewhat dissatisfied	3 – neither satisfied nor dissatisfied	4 – somewhat satisfied	5 – very satisfied	don't know/ no answer

ILS Problems

45. Have you had any problems, such as software bugs, with your ILS?

- Yes, we have had some ILS problems.
- Yes, but not sure if the problem was due to something else.
- No, we have had no ILS problems.

46. What types of ILS problems have you had (not including problems caused by underlying components such as network failure)? Select all that apply.

- Lapse in service
- Data loss
- Problems with OPAC/search engine
- Problems with circulation module
- Problems with cataloging module

- Problems with serials module*
- Problems with acquisitions module*
- Security breach
- Other (please specify)

Library Size

47*. How many books and serial volumes are in your library's collection? Your best estimate is fine.

48*. What is the population of your library's service area? Your best estimate is fine.

Costs

Can you please estimate the following costs in U.S. dollars?

49*. What was the cost of any new hardware, software, or network equipment required before installing your ILS?

The next two questions break down the ILS costs by initial and perpetual costs.

50*. The initial cost of the ILS may include the software, license fees, installation, configuration, migration of data from previous ILS, documentation, and training. What was the initial cost of your ILS?

51*. The perpetual costs of the ILS may include support contracts, maintenance, and license fees. What is the annual cost of your ILS?

The next two questions further break down the initial ILS cost into materials and labor costs.

52*. The initial materials cost may include software, documentation, and license fees. Can you please estimate the initial materials cost of your ILS?

53*. The initial labor cost of your ILS may include installation, support, and training. Can you please estimate the initial labor cost of your ILS?

The answer ranges for the cost questions, Q49–Q53, are:

- $0 - $500 USD
- $501 - $1,000 USD
- $1,001 - $2,500 USD
- $2,501 - $5,000 USD

- $5,001 - $7,500 USD
- $7,501 - $10,000 USD
- $10,001 - $25,000 USD
- $25,001 - $50,000 USD
- $50,001 - $75,000 USD
- $75,001 - $100,000 USD
- $100,001 - $500,000 USD
- $500,001 - $1,000,000 USD
- $1,000,001 - $5,000,000 USD
- $5,000,001 - $10,000,000 USD
- over $10,000,000 USD
- included in cost of ILS (Q. 47 only)
- don't know/no answer
- can give a closer estimate

Demographics

54. What is the name of your library?

55. What type is your library?

public academic special school other (please specify)

56. Where is your library located?

City:
State/Province:
Country:

Finish

57. Do you have any comments about your library's ILS or how it could be improved?

Appendix B: Table B1

ILS Satisfaction Ratings

	Open Source								Open Source vs. Proprietary		Koha vs. Proprietary		Evergreen vs. Proprietary	
	Subtotal		Koha		Evrgreen		Proprtry							
	n	ave	*n*	ave	*n*	ave	*n*	ave	*d*	*p*	*d*	*p*	*d*	*p*
Installation smoothness			100	2.9	1[a]	5.0	77	3.7			-0.8	.000		
Documentation completeness	167	2.8	82	2.7	85	3.0	107	3.4	-0.6	.000	-0.7	.000	-0.4	.013
Installation time			99	3.7	1[a]	5.0	78	4.2			-0.5	.008		
Orig cataloging ease of use	114	3.7	93	3.7	21	3.5	90	4.1	-0.4	.012	-0.3	.036	-0.6	.052
Cataloging ease of use	133	3.9	97	3.9	36	3.9	95	4.1	-0.2	.100	-0.2	.123	-0.2	.330
Reliability	217	3.9	104	4.0	113	3.8	114	4.1	-0.2	.130	-0.1	.683	-0.3	.034
Copy cataloging ease of use	123	4.1	89	4.1	34	4.1	90	4.2	-0.1	.454	-0.1	.500	-0.1	.603
Serials completeness			38	3.4	-	-	54	3.6			-0.2	.468		
Technical support	205	3.7	97	3.5	108	3.8	109	3.8	-0.1	.503	-0.2	.175	0.0	.873
Documentation	168	3.1	83	3.1	85	3.1	109	3.2	-0.1	.592	-0.1	.552	-0.1	.740
Circ/pat completeness	196	3.9	86	4.1	110	3.8	105	3.9	0.0	.718	0.2	.087	-0.1	.385
Circ/pat loans & returns	190	4.5	84	4.7	106	4.3	103	4.4	0.1	.610	0.2	.026	-0.1	.429
Cataloging completeness	131	4.0	96	4.2	35	3.5	97	4.0	0.1	.502	0.2	.026	-0.4	.009
Maintenance			93	3.9	1[a]	5.0	106	3.8			0.1	.362		
Acquisitions completeness			35	3.7	-	-	49	3.5			0.2	.248		
Circ/pat patron updates	194	4.3	85	4.4	109	4.2	105	4.2	0.1	.236	0.2	.047	0.0	.721
Circ/pat renewals & holds	191	4.3	82	4.3	109	4.2	102	4.1	0.1	.206	0.2	.107	0.1	.476
Acquisitions ease of use			35	3.7	-	-	47	3.4			0.3	.152		
Serials ease of use			38	3.4	-	-	52	3.0			0.3	.148		
Security	205	4.2	99	4.0	106	4.4	114	4.0	0.2	.121	0.0	.999	0.4	.007
Ease of use	228	4.0	112	4.0	116	4.0	128	3.8	0.2	.104	0.2	.161	0.2	.170
OPAC ease of use	219	4.1	107	4.3	112	3.8	118	3.9	0.2	.052	0.5	.000	-0.0	.958
Overall ILS satisfaction	228	4.2	113	4.3	115	4.1	126	3.9	0.3	.029	0.4	.008	0.2	.231
OPAC self-service	197	3.9	88	3.9	109	3.8	105	3.5	0.4	.007	0.4	.006	0.3	.035
Circ/pat ease of use	196	4.3	86	4.4	110	4.2	104	3.9	0.3	.002	0.5	.000	0.3	.038
Scalability			86	4.3	1[a]	5.0	102	3.8			0.4	.003		
OPAC completeness	219	3.9	107	3.9	112	3.8	118	3.6	0.3	.002	0.3	.001	0.2	.031
Features/functionality	227	4.1	112	4.2	115	4.0	128	3.7	0.4	.001	0.5	.000	0.3	.034
Portability	176	4.0	89	4.1	87	3.9	89	3.5	0.5	.001	0.7	.000	0.4	.034
Interoperability	192	4.0	100	4.0	92	3.9	96	3.5	0.5	.000	0.5	.000	0.4	.011
Customizability	219	4.0	109	4.3	110	3.8	125	3.4	0.6	.000	0.8	.000	0.3	.026
Affordability			106	4.6	1[a]	4.0	120	3.6			1.1	.000		

Note. Table is sorted by significance of difference of Open Source vs. Proprietary. *n* = number of responses; ave = mean satisfaction rating; *d* = difference in satisfaction ratings between sample groups; *p* = two-tailed probability value based on Welch's *t*-test for samples with unequal variances.
[a]Represents a consortium of 265 libraries.

Appendix B: Table B2

System Prerequisites Cost of ILS

	Open Source						Koha vs. Proprietary		Evergreen vs. Proprietary	
	Koha		Evergreen		Proprietary					
	n	ave	*n*	ave	*n*	ave	*d*	*p*	*d*	*p*
Collection size										
< 100 items										
>= 100 and < 500 items	1	$ 250								
>= 500 and < 1,000 items	5	2,050			1	$ 250				
>= 1,000 and < 10,000 items	39	981			3	6,000	$ -5,019	.475		
>= 10,000 and < 25,000 items	17	3,382			8	4,594	-1,211	.689		
>= 25,000 and < 50,000 items	5	2,150	265	$566	8	2,375	-225	.890	-$1,809	.112
>= 50,000 and < 100,000 items	4	4,750			11	48,318	-43,568	.133		
>= 100,000 and < 1,000,000 items	12	3,250			18	43,417	-40,167	.023		
>= 1,000,000 items					10	426,275				
Population size										
< 100 patrons	11	$1,250								
>= 100 and < 500 patrons	24	1,083			6	$ 3,333	$ -2,250	.089		
>= 500 and < 1,000 patrons	13	4,115			7	4,571	-456	.905		
>= 1,000 and < 10,000 patrons	21	2,393	265	$566	12	33,417	-31,024	.231	-$32,851	.206
>= 10,000 and < 25,000 patrons	5	2,350			9	11,611	-9,261	.117		
>= 25,000 and < 50,000 patrons	5	2,450			10	70,150	-67,700	.037		
>= 50,000 and < 100,000 patrons	1	1,750			5	632,000				
>= 100,000 and < 1,000,000 patrons	1	250			9	127,028				
>= 1,000,000 patrons					1	87,500				

Note. *n* = number of responses; ave = mean cost; *d* = difference in cost between sample groups; *p* = two-tailed probability based on Welch's *t*-test for samples with unequal variances.

Appendix B: Table B3

Initial Cost of ILS

	Open Source						Koha vs. Proprietary		Evergreen vs. Proprietary	
	Koha		Evergreen		Proprietary					
	n	ave	*n*	ave	*n*	ave	*d*	*p*	*d*	*p*
Collection size										
< 100 items										
>= 100 and < 500 items	1	$ 250								
>= 500 and < 1,000 items	5	1,950								
>= 1,000 and < 10,000 items	35	1,407			4	$ 25,125	$ -23,718	.218		
>= 10,000 and < 25,000 items	16	3,859			5	9,700	-5,841	.458		
>= 25,000 and < 50,000 items	6	5,958	265	$953	7	8,000	-2,042	.727	-$7,047	.210
>= 50,000 and < 100,000 items	5	19,250			11	78,364	-59,114	.127		
>= 100,000 and < 1,000,000 items	10	21,675			16	217,609	-195,934	.005		
>= 1,000,000 items					8	266,719				
Population size										
< 100 patrons	11	$ 1,386								
>= 100 and < 500 patrons	24	2,677			5	$ 5,500	$ -2,823	.423		
>= 500 and < 1,000 patrons	12	2,875			5	13,150	-10,275	.209		
>= 1,000 and < 10,000 patrons	18	7,472	265	$953	12	68,250	-60,778	.084	-$67,297	.059
>= 10,000 and < 25,000 patrons	4	2,500			8	56,125	-53,625	.177		
>= 25,000 and < 50,000 patrons	5	37,700			7	231,607	-193,907	.095		
>= 50,000 and < 100,000 patrons	1	17,500			7	164,286				
>= 100,000 and < 1,000,000 patrons	1	1,750			7	364,286				
>= 1,000,000 patrons					1	300,000				

Note. *n* = number of responses; ave = mean cost; *d* = difference in cost between sample groups; *p* = two-tailed probability based on Welch's *t*-test for samples with unequal variances.

Appendix B: Table B4

Annual Cost of ILS

	Open Source						Koha vs. Proprietary		Evergreen vs. Proprietary	
	Koha		Evergreen		Proprietary					
	n	ave	*n*	ave	*n*	ave	*d*	*p*	*d*	*p*
Collection size										
< 100 items										
>= 100 and < 500 items	2	$ 250								
>= 500 and < 1,000 items	5	450								
>= 1,000 and < 10,000 items	35	664			6	$ 4,708	$ -4,044	.203		
>= 10,000 and < 25,000 items	14	1,429			10	3,200	-1,771	.157		
>= 25,000 and < 50,000 items	6	1,917	265	$1,698	8	10,281	-8,365	.123	-$8,583	.108
>= 50,000 and < 100,000 items	5	2,550			12	18,167	-15,617	.017		
>= 100,000 and < 1,000,000 items	11	6,023			25	38,870	-32,847	.012		
>= 1,000,000 items					10	69,250				
Population size										
< 100 patrons	10	$ 300								
>= 100 and < 500 patrons	24	813			6	$ 2,583	$ -1,771	.259		
>= 500 and < 1,000 patrons	11	568			8	7,156	-6,588	.184		
>= 1,000 and < 10,000 patrons	19	2,066	265	$1,698	17	11,691	-9,625	.031	-$9,993	.024
>= 10,000 and < 25,000 patrons	5	550			10	15,275	-14,725	.006		
>= 25,000 and < 50,000 patrons	5	9,200			11	57,205	-48,005	.094		
>= 50,000 and < 100,000 patrons	1	17,500			7	30,357				
>= 100,000 and < 1,000,000 patrons	1	250			11	65,568				
>= 1,000,000 patrons					1	37,500				

Note. *n* = number of responses; ave = mean cost; *d* = difference in cost between sample groups; *p* = two-tailed probability based on Welch's *t*-test for samples with unequal variances.

Appendix B: Table B5

Initial Materials Cost of ILS

	Open Source						Koha vs. Proprietary		Evergreen vs. Proprietary	
	Koha		Evergreen		Proprietary					
	n	ave	*n*	ave	*n*	ave	*d*	*p*	*d*	*p*
Collection size										
< 100 items										
>= 100 and < 500 items	1	$ 250								
>= 500 and < 1,000 items	5	350								
>= 1,000 and < 10,000 items	36	306			2	$ 250	$ 56	.211		
>= 10,000 and < 25,000 items	15	383			5	4,700	-4,317	.257		
>= 25,000 and < 50,000 items	6	250	265	$0	5	3,150	-2,900	.126	-$3,150	.104
>= 50,000 and < 100,000 items	3	3,083			6	40,708	-37,625	.089		
>= 100,000 and < 1,000,000 items	9	250			7	44,821	-44,571	.002		
>= 1,000,000 items					4	97,375				
Population size										
< 100 patrons	11	$ 295								
>= 100 and < 500 patrons	23	337			2	$ 1,000	$ -663	.540		
>= 500 and < 1,000 patrons	11	295			3	5,917	-5,621	.186		
>= 1,000 and < 10,000 patrons	18	806	265	$0	8	8,063	-7,257	.168	-$8,063	.130
>= 10,000 and < 25,000 patrons	4	250			5	14,200	-13,950	.313		
>= 25,000 and < 50,000 patrons	4	250			4	112,563	-112,313	.183		
>= 50,000 and < 100,000 patrons	1	250			3	47,500				
>= 100,000 and < 1,000,000 patrons	1	250			3	79,167				
>= 1,000,000 patrons					1	1,750				

Note. *n* = number of responses; ave = mean cost; *d* = difference in cost between sample groups; *p* = two-tailed probability based on Welch's *t*-test for samples with unequal variances.

Appendix B: Table B6

Initial Labor Cost of ILS

	Open Source						Koha vs. Proprietary		Evergreen vs. Proprietary	
	Koha		Evergreen		Proprietary					
	n	ave	*n*	ave	*n*	ave	*d*	*p*	*d*	*p*
Collection size										
< 100 items										
>= 100 and < 500 items	2	$ 250								
>= 500 and < 1,000 items	5	1,950								
>= 1,000 and < 10,000 items	37	1,358			2	$ 250	$ 1,108	.002		
>= 10,000 and < 25,000 items	14	3,232			5	1,350	1,882	.205		
>= 25,000 and < 50,000 items	6	5,958	265	$953	4	375	5,583	.084	$ 578	.019
>= 50,000 and < 100,000 items	3	9,167			5	14,600	-5,433	.532		
>= 100,000 and < 1,000,000 items	11	18,023			8	34,719	-16,696	.218		
>= 1,000,000 items					5	139,300				
Population size										
< 100 patrons	11	$ 1,159								
>= 100 and < 500 patrons	24	1,521			2	$ 500	$ 1,021	.088		
>= 500 and < 1,000 patrons	11	2,523			2	8,875	-6,352	.597		
>= 1,000 and < 10,000 patrons	19	6,882	265	$953	9	47,833	-40,952	.251	-$46,881	.193
>= 10,000 and < 25,000 patrons	5	2,150			5	13,000	-10,850	.431		
>= 25,000 and < 50,000 patrons	4	31,500			4	37,813	-6,313	.825		
>= 50,000 and < 100,000 patrons	1	17,500			3	24,167				
>= 100,000 and < 1,000,000 patrons	1	1,750			3	6,000				
>= 1,000,000 patrons					1	300,000				

Note. *n* = number of responses; ave = mean cost; *d* = difference in cost between sample groups; *p* = two-tailed probability based on Welch's *t*-test for samples with unequal variances.

Appendix C: Glossary of Software Classified by Category of Intellectual Property

Free software is software that may be viewed, used, copied, modified, and redistributed. The source code is open to view. These freedoms are ensured by a reciprocal or "copyleft" license, which extends the freedoms to copies, identical or modified, of the software. Free software cannot be included in proprietary software. Any software that includes free software must also be free software. There is no restriction on what may be charged or not charged for free software; it may be and often is distributed at no cost. GNU/Linux is an example of free software.

Freeware, not to be confused with free software, is software that costs nothing. It is distributed in binary form without the source code, often available by download from the Web. Freeware may be proprietary software, copyrighted and licensed. Users are restricted from modifying the software, although redistribution may be permitted. The Adobe Acrobat Reader is an example of freeware.

Open source software (OSS) is for practical purposes the same as free software. Open source and free software are often licensed by the same licenses, such as the GNU General Public License. However, some open source licenses do not ensure all the freedoms that free software licenses do, such as the reciprocal clause. The difference between open source and free software is mostly one of emphasis. Free software emphasizes the user's right to freedom, and open source software emphasizes viewable source code. Sun Microsystem's Java is an example of open source software.

Patented software is software that contains a method or algorithm, the exclusive right to which is granted to the inventor by the state for a period of time (in the United

States, 20 years). A patent protects a method or algorithm in the software, whereas a copyright protects an expression of an algorithm. The criteria on which a patent is granted hold the invention to a higher standard than a copyright: utility, novelty, and nonobviousness. A patent excludes others from making, using, or selling instances of the invention. An inventor may sell licenses of these rights to manufacturers who may in turn pay royalty fees to the inventor for each item sold. Examples of software patents include media compression algorithms such as MP3 audio and DVD video compression. A patent would not generally apply to an ILS, because an ILS is commodified software, that is, the functions of all ILSs are fairly homogeneous and well known.

Proprietary software is owned by someone who has the exclusive right to distribute the software. The software is copyrighted. Transfer of use of the software is by a license, often called an End User License Agreement (EULA), which is a legal contract that specifies the terms of use. A license to use proprietary software generally does not permit copying the software. The software is distributed in compiled binary form and the source code is not revealed to users. Microsoft Word is an example of proprietary software.

Public domain software is the simplest type of software as intellectual property. This software is not copyrighted and has no restrictions. Copies or modified copies of public domain software can be copyrighted. Thus public domain software can be taken out of the public domain and made proprietary. By the Berne Convention (World Intellectual Property Organization, 1979), which is an international treaty regarding copyright, exclusive rights are automatically granted to authors as soon as a work is

fixed (e.g., written or recorded) in a physical medium. Therefore, to place a work in the public domain requires that the author forfeits rights to it or that the copyright expires. For example, Megginson (2000) wrote a group of subroutines for XML and placed it in the public domain by disclaiming his rights to it (Apodaca, 2006). Sun Microsystems (2004) incorporated it into their Java product with no obligation to Megginson.

Shareware is the same as freeware, except that shareware is available for a limited time period at no cost, after which it ceases to function unless a payment is made. WinZip 11.0 file compression software, which has a 45-day evaluation period, is an example of shareware.