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A Library’s Integrated Online Library System: Assessment and New Hardware Implementation

Jason Vaughan

For more than a decade, a consortium of academic libraries in southern Nevada has shared a central integrated online library system (IOLS), Innovative Interfaces’ Innopac (Innovative when referring to the vendor, Innopac when referring to the software). At present, this consortium includes the University of Nevada, Las Vegas (UNLV) (both the main university library system and the UNLV law library), the Community College of Southern Nevada, Nevada State College, and the Desert Research Institute. The last central-site server was purchased and installed in 1997. In the four intervening years, tremendous growth occurred with the system, necessitating a hardware upgrade. Prior to committing to a fiscally significant hardware upgrade, library management felt it prudent to conduct an analysis of the library-system-vendor marketplace in general, to validate the consortium’s continued commitment to the existing vendor. This article discusses background assessment work and the subsequent planning and installation of the consortium’s new central-site hardware.

The last central-site hardware for a consortium of academic libraries in southern Nevada was purchased and installed in the spring of 1997. At the time, the vendor indicated that the system purchased had enough memory and disk space to accommodate anticipated growth in users and data for the next three to five years. As reality sunk in that the libraries would need to upgrade the hardware, staff began looking at the true growth of the system, which proved to be quite substantial. The server’s memory had already been upgraded to help accommodate the growth. Between 1997 and 2001, bibliographic, item, and patron record counts had increased by 59 percent, 86 percent, and 26 percent, respectively. The number of dedicated staff logins to the system (that is, potential simultaneous staff users) had more than tripled from thirty-three to 105. System log files associated with these accounts showed consistent use, at peak periods, of nearly all available logins. End-user statistics—circulation and interlibrary loan statistics, OPAC searches, and proxy-server use—varied, some rising and others falling.

However, perhaps more telling than any statistic set, the libraries had added a tremendous amount of new software and routine responsibilities associated with the system, above and beyond regular vendor software updates. The University of Nevada, Las Vegas (UNLV) law library had joined the system, at which time additional acquisitions and serial units were installed. The library had installed an interlibrary loan module, an interface to the main library’s automated storage and retrieval system (ASRS), self-check units, Z39.50 client-server software, and proxy-server software. Innopac, by Innovative Interfaces (Innovative), had introduced their new Java-based Millennium system, part of which had been installed. In addition to software, massive item record lists were regularly created for use in conjunction with the libraries’ 3M Digital Library Assistant devices. The vendor’s patron application program interface (API) module was installed and used for patron authentication purposes. Clearly, the consortium had stretched the boundaries in terms of what was expected from the central-site hardware and, for that matter, traditional integrated online library systems (IOLS) functionality in general.

The effect of all this growth was obvious: lists and system backups took hours to create, staff menus took a long time to load—in short, things were slow. From a systems-analysis standpoint, could it be proved that the system was overtaxed and in need of an upgrade? Having obtained root-level access permission to the system, the library looked to measure system-load averages to provide some data-driven proof that the existing system was overburdened. An automated log program was created that continuously recorded central processing unit (CPU) load averages. The load average reflects the average number of processes waiting to access and be processed by the CPU (known as the run queue). Unix systems keep a running total of how many processes are running; at any one time, there are easily more than one hundred processes running on the Innopac system. A system not busy at all will have a load average approaching zero; a load average near one indicates that the system has been almost fully utilized (in other words, the CPU is in constant action—varied, some rising and others falling.

However, perhaps more telling than any statistic set, the libraries had added a tremendous amount of new

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Data were collected for a one-month period while school was in session. Figure 1 illustrates the findings. Maximum average peaks were recorded each hour and graphed for each day of the week. Without exception, Monday through Saturday, the system at some point reached a load average of four or higher; at some point on
most days, load averages reached five or higher. Overall, the data showed that while the system could stay afloat (absolute downtime on the system was extremely low), performance was not optimal at all hours of a typical workday. For rough comparison purposes, load averages were recorded more than a year later with the new hardware in place. The comparisons were not precise, apple-to-apple comparisons—the new server was running even more software than the old, and handling a new consortium member. Nevertheless, the maximum-recorded load average for the entire one-month period under the new hardware was 2.49 queued processes; a graph is provided in figure 1.

In sum, due to the increased workload expected of the Innopac server, the evolution of the system software, and ever more users present on the system, the libraries began the formal process of looking to upgrade the hardware in 2001. As such an upgrade would be a significant capital investment, it seemed to be an optimum time to conduct an assessment of the vendor marketplace prior to committing to an upgrade.

### Marketplace Assessment

A task force consisting of representatives from each consortium member was created in spring 2001. This group was charged as follows:

2. Agree on prioritized and weighted-performance criteria to assess the shared system using broad staff input.
3. Measure and evaluate the performance of the shared system against the criteria using broad staff input.
4. Recommend one of the following courses of action:
   - reaffirm the consortium’s commitment to Innovative as the vendor of choice with recommendations to upgrade and expand the existing system as appropriate; or
   - begin a formal review of the vendor marketplace with the intent of selecting a new vendor to replace Innovative.

Regarding the first charge (Innovative’s place within the IOLS marketplace), task force members reviewed information from several publications, a list of which appears in appendix A (in addition, several additional resources, compiled for the Library and Information Technology Association [LITA] Top Technology Trends Committee, are also listed). Several members informally visited various vendor booths at the 2001 American Library Association (ALA) Annual Conference to get a sense of how the Innopac system compared to others currently available. The following conclusions were reached regarding this first step of assessment:

- There were only three vendors (including Innovative) for whom academic libraries are the chief market. For law libraries, Innovative essentially owns the marketplace.
- At the time of review, Innovative ranked fifth out of seventeen vendors in terms of new-name sales the previous year, fifth out of nineteen vendors in terms of installed or accepted systems, and tied for first out of eighteen vendors in terms of total revenue. In short, they ranked in the top 30 percent of reporting IOLS vendors in each statistic. Innovative was founded in 1979, giving the company more than two decades of experience in a marketplace that sees many vendors come and go. Only two vendors, including Innovative, had all major IOLS modules in place at the time of assessment. Based on these considerations, Innovative was felt to be a strong company financially, and a strong, stable vendor in general.
- Innovative’s customer support ratio of 1:16 (the number of customer-support personnel compared to the number of Innovative libraries) was not ideal.

The second assessment goal was to measure and evaluate the performance of the system, using criteria determined with broad staff input. While input from students and other information seekers would have been nice, end users would have little, if any, knowledge of vendor
offerings in general, and more specifically, would only know the system from a single module, the public online catalog. Library staff evaluations were pursued via a written survey distributed to all consortium library staff currently sharing the system, excluding student workers. The task force agreed upon six evaluation criteria for this survey. The survey instrument is provided in appendix B.

Seventy-five usable responses—representing more than half of the library staff—were received, with three criteria strongly selected as the most important. (Tabulated results are provided in table 1.) In order of importance, the three criteria were “reliability and performance,” “user interface and functionality,” and “staff interface and functionality.” The other three criteria, rated less significant, were “non-mission-critical customer support,” “cutting-edge functionality,” and “practical considerations.” Due to the overwhelming importance given to three of the six criteria, the task force subsequently requested any additional comments from library employees regarding how well the vendor was performing in each of the top three criteria. Results indicated strong uniformity and agreement among all member libraries. For the top three criteria selected, the following was indicated:

- Reliability and Performance: In general, library staff thought the vendor was outstanding in terms of reliability (sustained uptime), but that hardware-related response time for the system was beginning to suffer.
- User Interface and Functionality: In general, library staff thought the vendor provided comprehensive user functionality, though there was some unhappiness with what appeared to be a rather inflexible online catalog interface, in terms of design and display details that could be determined by library staff. Some of the display issues were seen as confusing to library patrons.
- Staff Functionality and Interface: In general, library staff thought staff functionality was a major plus of the system. All major desired staff functionality existed and appeared to work well. Staff had the

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choice of two interfaces for many modules—the text-based traditional system, and the modern, Java-driven graphical user interface.

Staff were able to offer comments in a blank field on the survey. (Representative comments are provided in appendix C.) One area where the vendor was perceived as coming up short was the relative inability to customize the Web-based online catalog. The second was that the response time often lagged for “non-mission-critical questions” directed to the vendor, such as informational questions. Overall, however, there was general satisfaction with the current vendor. No staff comments were received to the effect that the consortium should seriously consider the idea of switching to another vendor’s system. Given the research, the task force chose to reaffirm the commitment to Innovative as the vendor of choice with a recommendation to upgrade and expand the existing system as appropriate. It was agreed that there was no need to perform any additional in-depth review or solicitation from other library vendors. In addition, the task force recommended the following:

- Replace the central-site hardware during the next calendar year (2002)
- Appoint a task force to redesign the Web OPAC user interface
- Add a separate index focused on journal and newspaper holdings to help end users locate these items
- Work with Innovative to help improve customer support with non-mission-critical inquiries such as training and resolving problems not involving system downtime

The remainder of this article focuses primarily on the preparatory research and subsequent experience with the new central-site hardware.

### Research and Purchase

As befits a large purchase and a reaffirmed commitment to the existing vendor, extensive and exhausting research regarding upgrade options was conducted. The libraries asked the vendor more than seventy background questions and solicited additional information from other Innovative libraries. Broadly, these questions—all of which were interrelated—were all focused on three key issues related to the upgrade choices. For example, particular platforms were recommended if Oracle was chosen as the underlying database system; particular platforms could only come with certain levels of support; costs varied according to which server was purchased and from what source. In order to understand both initial and ongoing maintenance-related expenses, appropriate cost information was requested for each option after the initial set of research questions. There were three primary issues about which the libraries sought information: vendor system support, the server hardware platform, and the underlying database management system.

### Level of Vendor System Support

For UNLV, system support can be defined by three criteria: vendor software support, Unix operating system support, and physical hardware support. The vendor offered various support levels, some of which were only available with certain hardware platforms or certain point-of-purchase considerations. At the time, the libraries had full turnkey support—the highest level possible—from the vendor, and sought to maintain this level of support for such a critical system. To help library staff at UNLV understand support choices, Innovative provided support-contract details, to which several additional follow-up questions were asked, such as:

- Approximately how many of your academic-library customers are vendor software-support-only sites (number and percentage of overall total)?
- What is the general trend—sites that were once software-support-only sites later switching to full-support sites, or full-support sites later switching to software-support-only sites?
- On average, in any given year, how many problems or issues reported to the vendor helpdesk are software in origin or hardware in origin?
- What are the most common causes or components involved with hardware problems?
- What players are involved in each level of support—library staff, Innovative, third-party service technicians?

### Choosing the Hardware Platform for the Server Upgrade

The vendor software was certified to run on several different hardware platforms, such as Compaq, IBM, and Sun. As the main library had other existing servers from Compaq and Sun, the choices were initially narrowed down to these two manufacturers. Questions were asked and issues were raised to help finalize the decision about which platform to purchase, including:

- What particular server models and CPUs are in use? How much average memory is used?
- Describe Innovative’s view on the future of Compaq and Sun as stable companies, and on their commitment to support their system on these two platforms.
- Does Innovative focus development on one platform?
A list of specifications (statistics, software installed) was provided, and the libraries sought the vendor’s general recommendations.

Choosing the Underlying Database Management System

At the time of these considerations, Innovative had recently begun offering Oracle as a database choice for Innopac, and over a dozen libraries had selected this option. Oracle had several advantages and disadvantages for the libraries to consider. In general, some advantages were:

- A growing trend toward Oracle as the database of choice in library management systems (several other library systems, such as Ex Libris and Endeavor, use an Oracle database). Oracle is the major database-software supplier in the library and educational markets.
- Oracle is Open Database Connectivity (ODBC)-compliant, meaning any ODBC-compliant third-party software can talk to the Oracle database. Library data can be accessed, extracted, and formatted by these third-party applications. This might be applicable not only for staff applications but for patron applications as well.

Some disadvantages included:

- Initial costs, both hardware and software related, were higher with Oracle.
- Maintenance options were fewer if the libraries went with Oracle.
- To take advantage of the benefits of Oracle, it is recommended to have a library staff member who is familiar with Oracle and can set up the necessary commands and query structures to extract and present the data. In addition, this person would preferably be versed in third-party applications used in conjunction with Oracle.

A number of additional Oracle questions were asked of the vendor, such as:

- How many current Oracle installations exist? Are they production or beta sites? What is the contact information for Innovative libraries that have installed Oracle?
- What hardware platforms are the existing installations using and what platform does Oracle recommend?
- What support options are available?

General comparison questions—concerning speed, querying, data extraction, functionality, look and feel, level of access to the database—were asked about the proprietary database versus the Oracle database.

- Amount of expertise needed with Oracle?
- Future company direction with database support—would the vendor continue to support both database options?
- Are there data migration issues from one database system to another?
- Are there licensing questions specific to Oracle?

In the end, the libraries chose a quad-processor Sun server, loaded with RAM, disk space, redundant components—the works. Initially, the libraries chose not to migrate to an Oracle database, but purchased a server that could clearly handle Oracle and configured it at RAID 0+1, recommended for any future Oracle migration. The libraries chose to purchase the server from Innovative and to obtain the highest level of support offered. The purchase order was cut in December 2001, with the server arriving and the subsequent upgrade occurring in May 2002, after the spring semester had concluded.

Replacing the Central-Site Hardware

As with any major system migration, unforeseen problems with the new server were somewhat expected. Despite extensive planning, several glitches did occur, most of which were fixed within a week’s time by the vendor. One problem involved the libraries’ interface between Innopac and the automated storage and retrieval system, which allows patrons to request stored items via the online catalog. This went down during the system upgrade, and was probably the most critical problem. Initial resolution took quite some time, and the problem subsequently reappeared at various intervals. Ultimately, a satisfactory patch was developed and applied to the system.

Regarding hardware failure, the first (and so far, only) problem did not occur until nearly a year after installation. One of the memory modules became faulty and was replaced early the following morning, taking advantage of the libraries’ 24/7 maintenance contract. All things considered, library staff have been very pleased with the new hardware. In general, things are much faster:

- Previous full-tape backups usually took three to four hours to complete. Toward the end, this had created some issues with overnight cron jobs (a cron job is an automated process that operates at predefined intervals)—for several months, staff had to make special provisions to conduct full backups on the single-tape drive, as two backup tapes were required for a single full backup. Using the tape backup unit that came with the new server, full backups take less than fifteen minutes and easily fit on a single tape. The libraries switched from the weekly routine of doing
one full backup and daily partials to doing daily full backups.

- Millennium applications sped up dramatically. Previously, it took a minute in some instances just to load the client menus on a PC; this now occurs in a few seconds.
- Tasks such as loading records and creating lists impact the new system far less than the old system, and are completed much quicker. For example, it previously took fourteen hours, more or less, to create, sort, and list data for one-third of the main library’s item holdings (around two-hundred-thousand records). The whole process now takes less than an hour. Staff no longer have to run lists overnight.
- As mentioned, only one hardware component failed during a year of operation. System uptime remains practically 100 percent.

With the upgrade complete, the libraries turned their focus to other recommendations mentioned in the original assessment report. One goal, since completed, was to “appoint a task force to redesign the Web OPAC user interface.” This task force investigated in-depth those things that could and could not be customized with the online catalog user interface, analyzed use statistics, conducted end-user usability testing, and patron and staff surveys. Following additional research and analysis, redesign recommendations will be forthcoming. Another goal was to install a separate serials index. Some problems developed with this plan as originally envisioned, but since the upgrade, the libraries have begun utilizing Serials Solutions to provide some accommodation of this goal. On another note, the system continues to expand. All of the currently available Millennium modules are loaded and slowly being brought into service. Since the upgrade, a new member joined the consortium, Nevada State College. The libraries upgraded to an Oracle database in January 2004. While the hardware capably handles the Oracle database, the libraries look forward to technical enhancements with the vendor’s specific implementation of the Oracle database in conjunction with the Innopac system, as well as its support for a more current version of Oracle. Such enhancements are expected later in 2004. The libraries have no doubt that the existing system will continue to serve the consortium well for several years down the line. Beyond that, only fools would offer predictions when it comes to the fast-changing world of information technology.

## Conclusion

A consortium of southern Nevada academic libraries has shared a central Innopac library system for more than a decade. Evolving and ever-increasing tasks associated with the system forced them to upgrade the hardware to keep pace with current requirements. Prior to committing to an expensive upgrade, common-sense management spurred the consortium to carefully assess the current vendor and decide whether to affirm that relationship or seriously consider other system vendors. After detailed research and solicitation of staff opinions on the current system, the decision was made to remain with the current vendor. Detailed research on system options and specifications led to the eventual upgrade and enjoyment of the upgraded hardware in place today.

### References


### Appendix A. IOLS—Information Resources


Smart Libraries Newsletter (formerly Library Systems Newsletter), www.techsource.ala.org, an annual survey of automated library-system vendors normally appears in the spring issue.
Appendix B. Innopac Assessment Staff Survey Form

The Innopac assessment task force would like your ideas about the relative importance of various assessment criteria for automated library systems. Below is a list of six assessment criteria listed in alphabetical order. We think you will agree that all of them are important. However, we would like your opinion about their relative importance. Please mark them 1 to 6 with 1 being most important, 2 being second-most important, and so on.

Please return this completed form to anyone on the Innopac assessment task force (see above) by August 1, 2001. We will issue a general communication with the results of this survey. Thanks.

_____ Customer Support. By this, we do not mean being responsive to immediate operational problems, as that is included in reliability and performance. Rather, we mean customer support in such areas as training, consulting, helping libraries resolve noncritical operational problems, and suggesting ways the library could better use the capabilities of the system. Included in customer support is an active and independent Users Group.

_____ Cutting Edge. The meaning here is a state-of-the-art system that is at the cutting edge both technically and functionally. Examples of current cutting-edge functionality in library systems are: highly customizable public and user interfaces and displays; creation of a portal for all library-selected resources; and the ability to search multiple user-selected databases with one search and receive an integrated result set with duplicate records removed. Examples of current cutting-edge technical considerations including open-system design strategy, client-server architecture, and scaleable to meet future needs.

_____ Practical Considerations. Practical considerations are such things as relative costs of the system (both purchase cost and projected ongoing maintenance cost), proven ability of the vendor to install systems in a timely and effective manner, and proven ability of the vendor to convert from another system to the new system in a timely and effective manner with a minimum of data loss.

_____ Reliability and Performance. In other words, a system that has very little downtime and very good response time. In addition, we mean a vendor that is very responsive to operational problems (quality customer support for operational problems) and has an established and proven track record in the marketplace. We have grouped system and vendor reliability and track record together because we believe the two are inevitably linked in that it is impossible, over time, to have a reliable system without having a reliable vendor supporting the system.

_____ Staff Interface and Functionality. This denotes a system that has all needed staff modules (circulation, acquisitions, serials, cataloging, database maintenance, statistics) and that they are powerful, easy to use, and intuitive.

_____ User Interface and Functionality. This means a system that has a Web-based graphical user interface online catalog that is easy to use, intuitive, powerful, clean, and fun. In other words, a system that patrons find user-friendly and that meets their needs.

Comments, Suggestions, Advice:

__________________________________________________

Appendix C. Sample Staff Comments

Ability to search multiple databases with one search interface is next evolutionary step. We need to be on cutting edge of this.

Innovative has been very reliable and easy to use as far as circulation goes, but response time is not always good, especially since we moved into the new library.

I think the ability to FTP or tape load records easily into the system is very important. Two of the functions I use a lot are the Create Lists function and the statistics module.

The capability to FTP lists to our PC or the file server is extremely useful. An easy-to-use system is very important for our patrons.

Though I have ranked staff interface a “3,” this assumes we would not even look at a system that did not have all the needed staff modules.

Since I am unfamiliar with the nuts and bolts, I rated the way I would rate considerations of the basic software given the expertise and aptitude of our staff (high).
Difficult to choose—they’re ALL important. Staff and user interface and functionality could be one category because the modules are different but needs are equally important.

Hard to extract user functionality from reliability.

I think that it is very important that the vendor be responsive to problems. Also that any system be compatible with other systems we have committed to. Innopac is compatible, but possibly functions could be more intuitive, powerful, clean, and fun on the staff side. Also customizability is important!

I am not sure I like the terminology for the Cutting-Edge category. A lot of these features are not just fancy extras, but tools we could use to alter the OPAC and provide functionality to best suit the needs of our staff and users. These are incredibly powerful features.

“Cutting Edge” should also emphasize Open Source so system programmers can build customized modules independently, if needed. For example, if it was an open database structure, creating personalized services could be an option. Does the system provide an API to facilitate programming?

I cannot emphasize enough the importance of an intuitive system. In order for staff to communicate among themselves and better serve patrons, all users must have an understanding of the system, and this is easier with a highly functional, intuitive system like Innopac. While it needs improvement, particularly with isolated modules that do not always translate well, it is fairly intuitive.

I know that customer support from Innovative has been lacking, but out of all the systems that I have worked with they have the best staff interface and best reliability and performance. Then again, it would not take much to be better than the others.

Reliability and ease of use are the most important factors.

Speed and reliability are very important to both patrons and staff. Also, avoiding slow-downs when staff use is heavy is important.