Library as place: results of a delphi study

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Objective: An expert consensus on the future of the library as place was developed to assist health sciences librarians in designing new library spaces.

Method: An expert panel of health sciences librarians, building consultants, architects, and information technologists was asked to reflect on the likelihood, desirability, timing, and impact on building design of more than seventy possible changes in the use of library space.

Results: An expert consensus predicted that the roles librarians play and the way libraries are used will substantially change. These changes come in response to changes in technology, scholarly communication, learning environments, and the health care economy.

Conclusions: How health sciences library space is used will be far less consistent by 2015, as space becomes more tailored to institutional needs. However, the manner in which health sciences libraries develop and deliver services and collections will drastically change in the next decade. Libraries will continue to exist and will provide support for knowledge management and clinical trials, provide access to digital materials, and play a host of other roles that will enable libraries to emerge as institutional change agents.

INTRODUCTION AND REVIEW OF LITERATURE

In recent years, the library literature has been filled with discussions of the changing nature of library services and spaces. A variety of distinctive trends—including declining gate counts, the rise of Internet search engines, the increasing amount of freely available information on the Web, and changes in student study habits—have caused many to question the future of the librarian's traditional role as organizer and provider of information resources. Librarians ask

themselves whether users will still come to the library, whether they will still value the organization that librarians provide in meeting their information needs, and whether the next generation of scholars, scientists, and clinicians will have the information-seeking skills, not to mention the patience, needed to locate quality information.

As a result of articles in the popular press, the question of the future of libraries has captured the attention of many nonlibrary professionals. Articles describing ''deserted libraries''—where gate counts and circula-

tion are falling as students find new study spaces in dorm rooms or apartments, coffee shops, or nearby bookstores [1]—have led administrators to question why they should support library construction or renovation. Noting that students, faculty, and the general public now tend to look to the Internet for answers rather than the library [2], administrators ask why librarians are needed. In this environment, funding and designing new buildings is particularly challenging. Capital planners may view libraries as an outdated concept, and even those who agree that libraries will still be needed are uncertain of their future function.

Librarians themselves tend to be much more positive about their futures. In a recent ''Panel on the Future of Libraries'' [3], library leaders have predicted expanded roles for libraries as places where all members of the community can come together, as repurposed and expanded learning centers, and as places for intellectual pursuits. Citing the rapid growth of poorly organized digital collections, librarians believe that people still need information professionals to assist them. Librarians also point to vast amounts of printed material that still must be preserved and organized; they question the ability of the Web to deliver quality information; and they look askance at the disorganized nature of information on the Internet [4].

Although few of these discussions focus on the physical nature of the future library, some space-related themes do emerge. Libraries, it is thought, will continue to provide group study spaces for individuals to engage in quiet pursuits and spaces for training in the use of information resources. Users will demand spaces that are comfortable for thinking and working, are conducive to long periods of screen use, and have support systems and help in place as well as quality output devices such as printers or high-definition screens [5]. Browsing will be an essential function of libraries, and libraries will retain a symbolic significance for scholars [6]. Libraries will also continue to be important as repositories of older physical information sources, although this information may be stored in only a few low-cost repositories. Infrastructure, amenities, and ''presence'' will characterize libraries; high-tech facilities such as electronic classrooms, information arcades, faculty support centers, and library cafes will be omnipresent; and portable computing will become ubiquitous [7]. Libraries will have computer-equipped classrooms and ample access to public computing facilities [8], and library buildings will continue to provide places for people and their activities, not just for storage of materials [9].

As these discussions on future use continue, health sciences libraries have been redesigning their facilities to meet the needs of the current generation of clinicians, faculty, and students. A mix of group and individual study spaces, combined service points that assist users with both technology and the use of information resources, more emphasis on consumer health information, and more attractive spaces are all features of newly built or renovated structures [10]. However, these facilities are designed to meet the needs of today's users. What about tomorrow's users? The typical health sciences library building can be expected to last at least twenty years. Given the pace of change, especially the pace of technological change, the needs of users today can scarcely be assumed to be the same needs as those that libraries will be serving many years hence. If libraries are being designed today for the users of 2025, what needs should be considered? To gain insight into the future, the authors conducted a delphi study of the health sciences library as place.

RESEARCH DESIGN

The origin of the delphi study dates back to research conducted in the 1950s at the Rand Corporation designed to ''obtain the most reliable consensus of opinion of a group of experts by a series of intensive questionnaires interspersed with controlled feedback'' [11]. After further development at Rand in the 1960s, the technique has been incorporated into a wide variety of projects aimed at long-range forecasting [12]. The basic premise of the delphi technique is that experts have the best idea of what the future may bring. Thus, unlike a typical user survey, the validity of a delphi study depends not on the number of participants polled, but rather on the expertise of the panel who participate. Most panels consist of five to twenty members [13].

Despite considerable variance in application of the technique, the most common delphi study begins with a questionnaire designed by a small team and sent to a larger group of experts. After the questionnaire is returned, the study organizers summarize the results, including the range of responses and the reasons experts gave for their responses, before sending this summary back to the experts. The experts are allowed the opportunity to change their responses based on the results, and these second-round results are reevaluated by the organizers. This process continues until consensus is reached or it becomes clear that no consensus is possible.

The delphi is not a statistically rigorous methodology for predicting the future. The lack of sampling, the impossibility of accounting for unseen future events, and the absence of clearly defined procedures and processes for conducting delphi studies are just a few of the features that differentiate it from controlled scientific methodologies. However, the delphi study is particularly valuable for problems that do not lend themselves to precise analytical techniques: where hard data are either insufficient or inconclusive, where no real models exist, and where bringing the needed individuals together to discuss the problem is difficult [14]. Using the delphi technique, a reliable expert consensus can be obtained because the technique relies on anonymity, controlled feedback, and statistical group response and is thus structured to avoid the influence of dominant individuals on group discussion or group pressure for conformity [15].

METHODOLOGY

For this ''Library as Place'' delphi study, the authors began by asking a small team of experts—a total of 14 librarians, architects, and space planners with recent experience in designing health sciences libraries—open-ended questions about possible future changes in library facilities and roles. Respondents were also asked to consider how changes in technology might affect future library space. From 80 pages of expert commentary, the researchers initially extracted over 200 change statements. Statements that the experts generally agreed on, that described fairly commonplace activities, or that were vague and/or difficult to interpret (Appendix) were removed from the list, leaving 78 opinion statements for the initial round of the Delphi study.

Requests for additional participants were sent to several email discussion lists for key opinion leaders in health care, librarianship, information technologies, and building and design. From the responses, an additional 16 individuals from a variety of backgrounds, but all with considerable experience in library design, were recruited to join the original 14 experts who responded to our initial set of open-ended statements. Thus, the final delphi study panel consisted of 30 experts (14 original experts plus 16 recruited from the discussion lists): 14 academic health sciences librarians, 2 library building designers, 3 corporate librarians, 5 hospital librarians, 2 information technologies administrators or managers, 2 library building consultants, and 2 senior health care administrators or managers.

In round 1 of the study, the seventy-eight opinion statements culled from the original group's commentary were posted to a survey Website. Each member of the panel was asked to rate each statement on five different Likert scales: ''Likelihood of Change,'' ''Desirability of Change,'' ''Certainty of Answer,'' ''Date Change Will Occur,'' and ''Impact on Design.'' They were also encouraged to provide comments explaining the reason for their responses. Statements for which there was a clear consensus and those for which there was substantial confusion, were eliminated, and then the Likert scale results from round 1 on each remaining question were presented to the panel as round 2. The round 1 comments were also presented in round 2, grouped as ''why'' or ''why not'' statements (Figure 1). Participants were asked to rate the statements a second time and provide additional commentary. These second-round results were reevaluated by the organizers, and again statements on which there was clear consensus or clearly no consensus were eliminated. The methodology was repeated for round 3 on a few remaining statements, for which it appeared that consensus might still be possible.

RESULTS

Table 1 summarizes the study results. Delphi studies differ widely on the definition of consensus. Here, we

Figure 1
Example of why and why not statements

31. By 2015, NLM's role as the library of record in biomedicine will become even more critical as libraries increasingly withdraw print and rely on NLM to hold print copies of older materials.

Why: This will free up space and reduce the size of the library. We'll have to rely on somebody. The trend will be reinforced by budgetary and space considerations. Libraries will rely on NLM to provide documents not available from electronic sources.

Why Not: NLM as a single library of record is very risky—better to have several. NLM may not have funding or space to provide a huge leap in copying services. This will happen slowly as larger libraries will hold onto their old junk for a long time.

define consensus as agreement by 65% or more participants. Such a consensus was achieved on 52 (69%) of the opinion statements. Our experts think the majority of these 52 changes are most likely to occur by 2015; most of them are viewed as highly desirable or desirable; and twenty are thought likely to have substantial impact on library design. An analysis of the commentary indicates that the changes our experts predict are the result of larger forces impacting libraries: changes in scholarly communication, in technology, and in the learning environments expected by a new generation of staff and users.

Scholarly communication

Our experts recognize that the way scientists communicate the results of their research is changing. The pace of change may seem glacial at times, but the advent of electronic journals combined with the spiraling cost of serial subscriptions certainly seems to be forcing health sciences libraries and their users to rethink the role of the traditional scholarly journal. Our experts believe that by 2015, the electronic article—rather than the journal, book, or book chapter—will be the chief unit of scholarly information. This change drives a host of other changes, many with substantial impact on library design. As the printed journal becomes less and less important as a source of information, our experts believe health sciences libraries will turn to compact shelving to handle what will be largely historical print journal collections. Remote storage will also become more attractive and more practical, as the print journal literature receives less use. By 2025, print collections will occupy only a small fraction of the space they consume today, and what print collections remain will, for the most part, be retained for their artifactual and historical, as opposed to clinical or educational, value.

Libraries will no longer differentiate themselves by collecting in specific subject areas unique to their institution's mission, and acquiring electronic information in concert with other libraries will leverage buying power. Browsing current journals will become predominantly an online activity; especially as current awareness software improves to encourage online perusal of newly released information. Departmental libraries will disappear as departments rely more on institutionally purchased licensing agreements for dig-

Table 1
Consensus statements by rank order of agreement

Consensus ranking	Agree %	Disagree %	Statement	Desirability and impact
1	99.9		#60: By 2010, with advances in authentication technology, wireless will be perceived as a secure means of communications and be ubiquitous on campus, in health sciences centers, and in health sciences libraries.	Very desirable change; some difference in design
2	96	4	#13: By 2010, a consumer health service point open to the public—either in the health sciences library, in a separate facility, or virtual—will become an essential function of the health sciences library.	Very desirable change; some to substantial impact, depending on whether service point is virtual or physical
2	96	4	#50: By 2010, at many institutions a close relationship will develop between the health sciences library and biomedical informatics, enabling libraries to emerge as institutional change agents.	Desirable change; may or may not impact the design of health sciences libraries
2	4	96	#53: The role of the health sciences library in providing user support with technology will disappear with a new generation of technologically sophisticated users and with advances in user-friendly technology.	Desirability, likelihood, and impact are uncertain
2	4	96	#69: By 2025, health sciences library facilities will no longer need to be physically supervised, because a smart building will provide its own supervision and security.	Neither desirable nor undesirable; substantial design impact
2	96	4	#31: By 2015, NLM's role as the library of record in biomedicine will become even more critical as libraries increasingly withdraw print and rely on NLM to hold print copies of older materials.	Very desirable; substantial design impact
2	96	4	#46: By 2005, most health sciences libraries will leverage their buying power with other libraries to acquire electronic information customized to the needs of their customer groups.	Very desirable; no to minimal design impact
2	96	4	#73: Libraries with separate circulation and reference desks will replace them with multifunctional service desks.	Very desirable change; substantial difference in library design
3	93	7	#22: By 2010, fewer low-level staff will be required and more senior staff with strong library and technical skills will staff the health sciences library.	Desirable; some difference in library design
4	92	8	#61: By 2010, with the introduction of ultra high bandwidth wireless technologies currently under development, bandwidth will no longer be an issue for libraries and their users.	Very desirable; some difference in library design
4	92	8	#51: By 2010, health sciences libraries will normally be responsible for providing online access to faculty and visiting experts' lectures, as well as for archiving these digital materials.	Somewhat desirable; minimal differences in library design
4	92	8	#72: By 2015, how health sciences library space is used will be far more inconsistent than today, as space becomes more tailored to the needs of the institution.	Very desirable; substantial difference in design
4	92	8	#39: By 2010, compact shelving and remote storage will become the commonplace solution for housing older print materials.	A very desirable change; substantial difference in library design
4	92	8	#52: By 2015, many academic health sciences libraries will be integrated into multifunctional buildings.	Somewhat to highly desirable; substantial design impact
4	92	8	#35: By 2010, browsing current journals will become predominantly an online activity as the number of print issues drops and as current awareness software improves to allow for more equivalent browsing online.	Desirable change; significant difference in library design
5	92	8	#55: By 2010, interactive health sciences library Websites that provide answers to the public's consumer health queries will become commonplace.	Very desirable change; minimal design impact
5	8	92	#56: By 2015, few institutions will have a health sciences library due to the easy, yet secured, ability of desktop access to information.	Undesirable; substantially different design
6	89	11	#16: By 2010, it will be common for health sciences libraries to provide access to food services (i.e., coffee and snack bars) within or adjacent to the library.	Very desirable; some to substantial design impact
7	88	4	#65: By 2015, the electronic article—rather than the journal, book, or book chapter—will be the chief unit of information.	Desirable; some difference in building design
7	88	4	#54: By 2010, the majority of hospital public Internet Websites will include access to a virtual library as well as access to hospital library services.	Desirable; minimal design impact

Table 1
Continued

Consensus ranking	Agree %	Disagree %	Statement	Desirability and impact
8	88	11	#42: By 2005, most health sciences librarians will work in partnership with public librarians to support the public library's function in serving the health information needs of the general public.	Very desirable; minimal design impact
8	88	11	#9: By 2010, a significant number of library staff will hold positions such as informationists, curriculum liaisons, and outreach specialists that require them to spend a considerable portion of their time working with users outside the library.	Desirable; some difference in design
8	88	11	#23: By 2015, health sciences library offices will be commonly equipped with desktop video to enable face-to-face support with users and coworkers when needed.	Desirable; some difference in library design
9	86	5	#25: By 2010, the academic health sciences library, working in concert with information technology (IT) departments, will play a substantial role in archiving locally developed electronic resources.	Desirable; some difference in design
10	86	11	#19: By 2005 learning commons will be commonplace in academic health sciences libraries.	Very desirable; substantial design impact
11	86	14	#8: By 2007, health sciences librarians will commonly provide instruction and classes (face-to-face and electronically) in how to locate health-related information for senior, community, and religious groups.	Very desirable; minimal to no difference design impact
11	86	14	#24: By 2010, less space will be required in workroom areas for equipment.	Desirable change; minimal design impact
12	82	7	#15: By 2010, lounge seating will be used in concert with tablet-type computing devices (mostly personal wireless devices) provided by the library or by users.	Highly desirable; some to substantial differences in library design
13	82	14	#4: By 2007, the majority of faculty will regard health sciences librarians as partners in curriculum development teams.	Some design changes if classrooms and labs are part of the equation
13	14	82	#14: By 2005, health sciences libraries will largely replace enclosed group study rooms with open areas designed for quite study.	Undesirable change; some to substantial design impact
13	82	14	#21: By 2010, most health sciences library staff offices will merge into collaborative work environments supporting team-based, cross-functional work.	Very desirable; substantial difference in design
14	82	18	#17: By 2015, instructional spaces for activities such as distance-learning classrooms, media labs, presentation facilities including auditoriums, and configurable teaching spaces located *in* a few academic health sciences libraries will be managed by them.	A desirable arrangement that will have substantial effect on library design
14	82	18	#1: By 2010, most users will primarily come to a health sciences library not for access to information, but for time-saving or value-added information services and places to collaborate and study.	Desirable; moderate to considerable design impact
15	81	15	#44: By 2015, most health sciences libraries will emerge as centers for knowledge management and become known as places that are designed to support the full spectrum of activities from knowledge creation to knowledge utilization.	Very desirable; some to substantial impact on library design
15	15	81	#27: By 2020, health sciences libraries will no longer differentiate themselves by collecting in specific subject areas unique to their institution's mission.	Somewhat desirable; some effect on design
16	81	18	#64: By 2015, departmental health sciences libraries will disappear as departments rely more on institutionally purchased licensing agreements for digital resources.	Very desirable; minimal difference in design
17	81	19	#38: By 2015, the manner in which health sciences libraries develop and deliver service and collections will drastically change.	Uncertain desirability; substantial impact on library design
17	81	19	#40: By 2015, many health sciences libraries will develop branded resource centers for outreach that are embedded in community complexes and/or near clusters of convenient amenities.	Desirable; some difference in library design
18	77	11	#58: By 2015, substantial space will be provided for users to interact with technologies such as 3D modeling, advanced visual displays, and immersive environments.	Highly desirable; substantial design impact
19	12	77	#59: By 2015, health sciences libraries will manage or operate the IT department for their institutions.	Perceived as neutral causing some difference in design

Table 1
Continued

Consensus ranking	Agree %	Disagree %	Statement	Desirability and impact
20	77	15	#43: By 2010, instruction in the creation and use of complex graphic databases and multimedia will become a commonplace function of health sciences libraries.	Desirable; some design impact
21	77	19	#48: By 2010, the health sciences library will no longer be thought of as primarily a physical place but as an entity that provides access to highly competent information-management professionals.	Uncertain desirability; some impact on design
21	77	19	#70: By 2010, it will become commonplace for health sciences libraries to create more connections to industry and form partnerships that permit wide use of their valuable information resources.	Somewhat desirable; minimal design impact
22	76	23	#62: By 2010, there will be little need for health sciences libraries to provide desktop machines, as most users will carry highly portable personal devices, but some accommodation for walk-in users without equipment will still be necessary.	Very desirable; substantial differences in library design
23	74	22	#74: By 2010, socializing per se is unlikely to be a major function of health sciences libraries; however, more library space will need to be devoted to group discussion and collaborative study and learning.	Desirability uncertain; some effect on library design
24	73	23	#41: By 2010, health sciences libraries will have primary responsibility for acquisition, instruction, and access to genomic and other databases and image repositories.	Desirable; mixed impact on library design
24	73	23	#30: By 2025, except in a few libraries with responsibility for the historical record, print collections in health sciences libraries will occupy only a small fraction of the space they consume today.	Uncertain desirability; substantial effect on library design
25	19	69	#29: By 2020, libraries serving hospitals will provide recreational materials in all media for patients during their hospitalization.	May or may not be desirable; some effect on design
26	69	27	#28: By 2015, print collections will, for the most part, be retained for their artifactual and historical value, as opposed to clinical or educational value.	Uncertain desirability; major impact on building design
27	68	32	#5: By 2010, electronic collaboration between researchers and health sciences librarians will greatly reduce the need for face-to-face interaction.	Undesirable; some difference in library design
27	68	32	#20: By 2010, users will come to the health sciences library primarily to interact with experts in locating and managing information.	Desirable; some differences in library design
28	19	65	#68: By 2025, the role of the academic health sciences library as an iconic symbol for the institution and as a welcoming interface will disappear.	Undesirable; impact unclear
29	16	65	#39: By 2010, it will be commonplace for health sciences libraries to support the clinical trials and internal review board activities of their institutions.	Desirable; some impact on library design

ital resources. When onsite print collections decline, the National Library of Medicine's (NLM's) role as the library of record in biomedicine will become even more critical; libraries will rely on NLM to hold print copies of older materials. The experts caution that relying on a single library for older print could be a risky strategy and that additional funding for NLM would be required to allow it to support such a role. The design implications of these changes are clear: our future libraries will have smaller footprints for print collections, including current journal displays, as well as for the facilities such as copiers and index tables that supported use of print, and they will need to be constructed to handle compact shelving for the collections that remain.

Our experts firmly believe that, by 2015, while the manner in which health sciences libraries develop and deliver services and collections will drastically change, the health sciences library would continue to exist, even in an era of easy desktop access to information. However, given the shortage of space in most health sciences enterprises, they also believe that other uses for space formerly holding collections would soon be found. They predict that many academic health sciences libraries will be integrated into multifunctional buildings. As paper collections are removed, libraries will have the opportunity to invite new partners into the remaining space.

Similarly, by 2015, they predict that academic health sciences libraries will house and manage instructional spaces for activities such as distance-learning classrooms, media labs, presentation facilities including auditoriums, and configurable teaching spaces. They point out that the library offers a likely place to support these functions, and, as the cost of building grows and the need for stack space lessens, they think it inevitable that institutions will try to recoup costs by combining spaces. Overall, our experts believe that how health sciences library space is used will be far more inconsistent by 2015, as space becomes more tailored to institutional needs. The library's design and mission will depend on the mission and needs of the parent institutions. Libraries, they said, will definitely become more reflective of their parent institutions' needs or they will perish.

Instead of acquiring and managing print collections, our experts envision new roles for libraries and librarians, roles driven by the changes in scholarly communication. They believe that our health sciences libraries will emerge as centers for knowledge management and become known as places designed to support the full spectrum of activities from knowledge creation to knowledge utilization. By 2010, our experts believe that health sciences libraries will have primary responsibility for acquisition, instruction, and access to genomic and other databases as well as image repositories. Libraries will be responsible for providing online access to a variety of new digital materials, such as faculty lectures, as well as for archiving these materials for their organizations, in concert with their information technology (IT) departments. A close rela-

tionship will likely develop between the health sciences library and biomedical informatics, enabling libraries to emerge as institutional change agents. The library will support clinical trials and internal review board activities for their institutions.

In this environment, more highly skilled staff with strong library and technical skills will replace minimally trained staff. These changes will undoubtedly affect building design, although not as directly as declining needs for stack space. Space will be required for staff to carry out their new roles and for equipment that can support these activities. Service points once devoted to assisting users with the collection will be modified to permit quiet and sustained consultation with users of the libraries' new services. More space will likely be needed for staff to develop access to virtual collections of library materials.

Technology

Our experts expect technology to continue to advance. They believe that by 2010, with improvements in authentication technologies, high bandwidth wireless will be perceived as a secure means of communication and be ubiquitous on campus, in health sciences centers, and in health sciences libraries. Some accommodation for walk-in users without equipment will still be necessary, but, for the most part, health sciences libraries will have little need to provide desktop machines. Most users will carry highly portable personal devices, and lounge seating will be designed for use of wireless devices provided by the library or by users. Substantial space will be provided as well for users to interact with technologies such as three-dimensional modeling, advanced visual displays, and immersive environments. The experts firmly disagree with a suggestion that, by 2025, smart buildings that provide their own supervision and security would exist, saying that cost would make such a move prohibitive.

The experts also disagree with the statement that the role of the health sciences library in providing user support for use of technology will disappear with a new generation of technologically sophisticated users and advances in user-friendly technology. They point out that the IT environment tends to get more complicated, rather than less, and that many health sciences library users are too busy not to use the expertise of trained professionals as a resource. In fact, they think that as soon as 2010, users would come to the health sciences library primarily to interact with experts in locating and managing information. The library will no longer be thought of as primarily a physical place but as an entity that provides access to highly competent information management professionals. New roles, with important implications for building design, will emerge.

By 2015, many health sciences libraries will manage or operate the IT departments of their institutions. By 2010, instruction in the creation and use of complex graphic databases and multimedia will become a commonplace function of health sciences libraries. Also by 2010, electronic collaboration between researchers and

health sciences librarians, such as that provided by virtual reference services, will greatly reduce the need for face-to-face interaction, while library offices will be equipped with desktop video to enable face-to-face support when needed. The experts caution, however, that personal interaction will always be needed to successfully develop and deliver information resources.

While traditional collection development activities might dwindle, technology will allow support for the institution's patient care mission to grow. The majority of hospital public Internet Websites will include access to a virtual library as well as access to hospital library services, and a consumer health service point open to the public in the health sciences library, in a separate facility, or in a virtual form will become an essential function of the health sciences library. Interactive health sciences library Websites that provide answers to the public's consumer health queries will become commonplace.

The impact of these technological changes on building design is easy to imagine: fewer stationary computers and, therefore, fewer computer tables, cords, and printers; more seating designed to support the use of portable wireless devices; more classrooms equipped for use of advanced technologies; and more space for staff to learn these technologies and design modules to introduce them to users. Library buildings will require the infrastructure to support advanced technologies, high bandwidth, and use of wireless devices. Staff spaces might need to be relocated to position staff to provide support to an increasingly technologically dependent clientele.

Learning environments

Between now and 2025, a new generation of users will enter our libraries. They will likely be more technologically sophisticated than their predecessors, more inclined to work in groups, and more exposed to problem-based learning. These new users will demand that libraries provide different learning environments to support their study and research. Our experts believe that by 2010, most users will primarily come to a health sciences library not for access to information, but for time-saving or value-added information services and for places to collaborate and study. This change, of course, is predicated on licensing that permits access to information from offices and labs. To attract users, it will be common for health sciences libraries to provide access to food services, within or adjacent to the library. Learning commons will become commonplace as well, as users need help with both the use of information and the tools to access it. Libraries will continue to include both enclosed group study areas and open areas designed for quiet study to satisfy user needs for both group work and privacy. To improve customer service, libraries will create a multifunctional desk that combines circulation and reference. The library will continue to be an inviting place. Our experts disagree with the suggestion that the role of the academic health sciences library as an iconic

symbol for the institution and a welcoming interface will disappear.

Staff spaces will change as well. By 2010, most health sciences library staff offices are likely to merge into collaborative work environments supporting team-based, cross-functional work. Some staff may well spend considerable time outside the library. Our experts think that health sciences librarians will soon work in partnership with public librarians to support the public library's function in serving the health information needs of the general public. They will likely provide instruction and classes (face-to-face or electronically) in how to locate health-related information to senior, community, and religious groups, and, by 2010, a significant number of library staff will hold positions such as informationists, curriculum liaisons, and outreach specialists that require them to spend a considerable portion of their time working with users in their offices and labs.

As described earlier, many recently designed libraries have already moved to accommodate these changes. Learning commons, group studies, and food courts are no longer uncommon features of libraries. If our experts are correct, however, in their prediction that, by 2010, users will no longer come to the library for access to information, then libraries wishing to remain relevant need to quicken the pace of change and rapidly introduce these and other features that will provide the value-added and time-saving services users crave. However, our experts caution that as campuses become pressed for space, it would be hard to justify the expense of building library spaces merely to promote socialization. Thus, libraries will need to stay focused on designing spaces that promote use and management of information resources.

Non-consensus

While the purpose of a delphi study is to develop a consensus among experts regarding the future, an analysis of those instances in which a consensus could not be obtained is also enlightening. By understanding why experts disagree, insight into the variables that make it difficult to predict the future can be gained. In this study, we failed to achieve consensus on close to one-third of the change statements. We analyzed these twenty-three statements (Table 2), seeking to understand why a future that seems quite probable to many of our experts appears extremely unlikely to others.

By far the most common cause of disagreement is economics. In many cases, half the experts believe a change would occur and the other half argue against the change on the grounds that it is unlikely to be cost effective. For example, while some experts think that, indeed, academic health sciences libraries would become the only safe gathering place available 24/7, others argue that this would not occur because other cheaper ways exist to provide a safe late night haven for students, faculty, and clinicians. Similarly, some experts think that informationists would become com-

Table 2
Non-consensus statements by rank order of agreement

Statement	Reasons for uncertainty	Desirability and impact
#2. By 2020, the academic health sciences library on urban campuses will be the only safe gathering place available 24/7.	Other facilities exist that are better equipped and more appropriate that can and should provide safe gathering places at much less cost; not a real part of the library's mission. [E]	Highly desirable; some difference in library design
#3. By 2010, the general public will become the heaviest onsite users of physical health sciences libraries.	It will be professionals that need in-depth consultation with information professionals or need to collaborate with them on curriculum support; security, inconvenience, parking will inhibit access by the general public; will vary by type of library (public or private) and its funding. [E]	Some difference in library design
#45. By 2025, with the advent of easier search mechanisms and more widely available electronic information, users will no longer look to the health sciences library for literature searching, interlibrary loan, orientation, and training.	Licensing for document delivery and training will continue as primary functions; the librarian-user interface will be with us as long as technology outpaces human ability to keep up with it; users will still need the assistance of trained professionals for complex searching and training; users will go to the library if they can get the service for free. [H]	Very undesirable; substantial design impact if it occurs
#57. By 2015, theft detection systems will become transparent, allowing automatic identification of any item that is taken out of the library as well as the user who took it.	Privacy issues need to be addressed; this kind of technology is frightening; libraries will have other ways they would rather spend the money. [E]	Very desirable; some difference in library design
#71. By 2015, many health sciences libraries will need to be open 24/7 to support clinical care around the clock and to serve remote users in different time zones.	24/7 needs will be met with technologies, not people in a library; clinical sites may access all they need remotely, therefore negating the need to be open 24/7; budget cuts are driving down hours now; virtual access is a reality 24/7; not a sufficient need to justify expenses of physical building being open. [E]	Desirable change; some difference in library design
#47. By 2020, large health sciences libraries will typically serve as publishers of their institutions' scientific and biomedical information.	The cultural issues (tenure and promotion, the status of publication in existing journals) work against this; centralized subject-oriented resources work against the local publishing of anything other than minor, limited-use, or highly specialized information resources; complexities of publishing and peer review will keep this in the hands of others. [I]	Desirable; impact on design is uncertain
#49. By 2010, it will become common for institutions to assign the health sciences library the responsibility for providing space for public events and to serve as a welcoming statement to the community.	Depends on the mission of the institution; this will be the responsibility of other hospital departments. [I]	Uncertain desirability; if occurs, will have substantial impact
#36. By 2025, much of the existing stack space in health sciences libraries will be converted to other uses.	Libraries will still have some reference and general print; few technological innovations completely replace the prior medium; both will continue in parallel like radio and TV. [H]	Uncertain desirability, substantial impact on design
#32. By 2020, most academic health sciences libraries will become repositories for their institutions' large databases and data sets.	So many turf wars involved; depends on the institution and what other alternatives exist. [I]	Desirable with some difference in design
#34. By 2010, small, specialized library collections managed by a health sciences librarian will become commonplace at the community YMCA, senior centers, nursing homes, and other locations that have developed joint programs with hospitals.	Assumes that print-based resources will still be predominant; may distract resources from main mission; economic climate will have to improve for this to occur; the Web will obviate this outcome; will spread professionals too thin. [E]	Desirable; some to minimal design impact
#63. By 2015, with the widespread introduction of sophisticated materials-handling systems, processing and circulation of remaining print and other materials will dramatically reduce the need for limited-skills staff.	Less trained staff is one of the biggest myths of technology; if physical materials keep dwindling, will it be cost effective to automate handling of so few items?; in smaller libraries, no staff would be eliminated because clerks or volunteers do these tasks. [E]	Somewhat desirable; some design difference
#67. By 2015, most health sciences libraries will be located in "prime real estate" locations consistent with their customer-service mission.	Only insofar as a given library reinvents itself and adopts a new set of services; the reality is that the library is not the center of focus for all institutions; very institution specific. [I]	Very desirable; some effect on library design
#30. By 2020, most academic health sciences libraries will only retain older print collections needed for research or unavailable in electronic format.	Older print collections have been underrated in terms of value for research; electronic environment still leaves a lot to be desired; it will be many decades before we can even begin to think about no print; hospital libraries will always retain some print; some users will prefer print for some purposes. [H]	Uncertain desirability; substantial design effect
#18. By 2015, the space devoted by most academic health sciences libraries to exhibits and exhibitions will be at least double what it is today.	Exhibits consume a lot of resources and take a lot of work; this is an important knowledge-management function and may be another use for unused stack space. [E]	Desirable change with substantial design impact

Table 2
Continued

Statement	Reasons for uncertainty	Desirability and impact
#11. By 2015, most academic health sciences library staff will telecommute at least part of the workweek.	The need for personal space, difficulties in changing management perceptions, and space sharing as a source of considerable conflict will make space sharing unlikely; loss of visibility in the eyes of executives is a perceived danger and may be costly in terms of funding. [H]	Desirable with some design difference
#26. By 2015, most health sciences libraries will serve as a central repository for faculty and student research data (e.g., information found in laboratory notebooks).	Current culture works against this; little added value; more likely as a repository for student and faculty publications than for their raw data. [I]	Desirable with some design difference
#33. By 2010, hospital-based libraries will have significant materials available in the foreign languages represented in the hospital service area.	Budgets will not increase to support this; libraries will rely on Websites in multiple languages instead; there will be more reliance on technology to translate information. [E]	Very desirable change; little impact on library design
#12. By 2010, many hospital-based libraries will provide a business center for patients' families and visitors.	Hospital administration may not want this "patient" service located in the library; libraries are not business centers and cannot provide professional-level services while assuming additional "clerical" roles; hard to compete cost effectively with places like Kinko's. [E]	Desirable; some difference in library design
#7. By 2010, hospital-based health sciences librarians will frequently serve as proctors for employees taking distance-learning exams.	This is a role that can be filled by less highly trained staff, and computer-based online testing will reduce the need for proctored exams. [E]	Uncertain desirability; minimal design impact
#10. By 2010, academic health sciences library staff with specific subject or technical expertise will be shared by multiple libraries by those in need of those areas of expertise.	The competing nature of various institutions and difficulties in determining who pays makes this change difficult; there may be political or administrative barriers; few librarians have in-depth subject expertise. [H]	Desirable; uncertain design impact
#37. By 2015, academic health sciences libraries will play a major role in organizing and managing the process of screening and certifying locally produced manuscripts for deposit into digital archives such as PubMed Central.	Few librarians are qualified to do this, and they do not have the time; would NLM abrogate this responsibility? [H]	A somewhat desirable change with no to minimal design impact
#6. By 2010, clinicians will have much improved access to health sciences library liaison services provided by informationists on their clinical teams, trained in their disciplines.	Unresolved cost issues in uncertain economies, lack of adequate decision support tools, and resistance to adding "non-medical" personnel to clinical teams make this change uncertain. [E]	Desirable; some differences in library design
#66. By 2010, health sciences libraries will provide more remote computing facilities and have larger areas devoted to servers and backup equipment, despite the gains from more storage capacity and smaller machines.	Servers will get faster, smaller, and much cheaper; in the hospital setting, these will be located in the computer services area; technology may be getting smaller, but we seem to need more of it. [E]	Neither desirable or undesirable; some difference in library design

Larger forces impacting health sciences libraries: I = institutional variation; E = economic barriers; and H = human factors.

mon in hospitals, while others point to the high cost of providing this service.

Institutional variation is also a frequent cause of dissension among the experts. What one institution values, another does not. Thus, some institutions welcome the public, providing them with parking and other amenities. Experts from these institutions believe the public would be frequent users of health sciences libraries and that the health sciences library would provide space for public events. Experts from institutions that try to avoid use by the public believe that these descriptions of the future are unlikely. Experts from libraries with sophisticated information technologies think that libraries are likely to become repositories for their institutions' large databases and datasets; those where another department has this responsibility doubt that libraries would take on this role.

Finally, our experts in many cases have differing views of human nature. Some think users would welcome a particular change; others think that change would be resisted. Some believe that users will continue to want printed materials, will need trained professionals to help with complex searches, and will resist telecommuting. Others believe that users would be glad to give up print, delighted to do their own searching, and enjoy not coming into the office on a regular basis.

SUMMARY AND CONCLUSION

The rate of change and the amount of conflict that the change creates has a direct correlation: the faster the change, the more conflict can be expected. Groups have a natural tendency to resist rapid change, for the status quo is maintained by the desire of members not to rock the boat, by group traditions, or by members' self-interests. When these forces are in balance, the status quo is maintained, but, as one set of forces gets noticeably stronger, change happens. Responses to this delphi study reflect the impact that environmental changes in scholarly communication, technology, and preferred learning environments are having on current library building design. Librarians have recognized that it is in their self-interest to respond to these changes. Without changes, libraries are likely to become deserted and librarians' skills underutilized. Thus, the pace of change in our libraries can be expected to increase, and many more design changes will be seen in the not too distant future.

Our experts clearly expect librarians to take on a wide variety of new roles, from informationists and educators to archivists and knowledge managers. They expect libraries to fill empty spaces left by shrinking print collections with new services ranging from classroom spaces to visualization laboratories to consumer health collections. While the impact of these new roles on building design is less obvious, perhaps, than the move to personal wireless devices or the desire for food services, these roles are likely to produce radical changes in library design, library space, and

adjacencies of those spaces to each other, to staff, and to users.

How should libraries be built in this time of change? William J. Mitchell, dean of the School of Architecture and Planning at the Massachusetts Institute of Technology, in discussing the creation of learning spaces, points out that

Spaces that work well over the long term are spaces that are built around very fundamental human needs like comfort, natural light, operable windows, good social ambience, nice sort of quality, views out the window....because people don't change very much, those things remain important. [16]

As these fundamental needs are considered in building, flexibility also needs to be included. As Mitchell went on to say,

The incredible unpredictability of the engagement of technology with culture is the lesson that comes out over and over again, which means you've got to be incredibly sensitive to the way technology and culture come together and ready to rethink assumptions and develop new experiments and transform the way you do things. You've got to be able to turn on a dime. [16]

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APPENDIX

Change statements of commonplace activities or with preexisting general agreement

From the opinion statements provided initially by the building experts, the researchers noted the following about the statements listed below: (1) general agreement for the statement or (2) activity described is fairly commonplace in today's health sciences libraries. For these reasons, the researchers elected not to include them in the delphi study or to include more focused statements about the opinion expressed.

Comments about all users

■ The informatics skills and knowledge of library users will be very heterogeneous.
■ Walk-in traffic will diminish, as users become more proficient with online searches.
■ The experience of the library will be a hybrid of both physical and virtual elements.
■ Physical service points will be primarily electronic, and study spaces will be more informal, connected, and available.

User space

■ More space will be dedicated to services and the specialty services they will provide.
■ Index table areas will disappear and be replaced by information access computers.

General space

■ More space will be required to accommodate students' collaborative project work.
■ There will still be "old fashioned" study, both individually and in groups, but more creature comforts will be expected.
■ Space allocated to copiers will be replaced by the need for distributed print centers with clustered networked printers.

Collections

■ The health sciences library will continue to house institutional archives.
■ Each library will have redefined their retrospective responsibility in relation to their user populations' needs and their particular collections and have evaluated how much print material to retain and where to locate it.
■ Libraries will continue to be repositories of the scholarly record but primarily in terms of being centers for the management of digital repositories and networked information systems.

Roles

■ A major role for health sciences libraries will be to support the information needs of remote students, preceptors, and practitioners.
■ A key role for health sciences libraries will be to help users learn to manage information across disciplines and to support interdisciplinary research initiatives and collaboration.
■ Outreach health sciences library services will become commonplace.
■ Where the library "fits in" and the role of the library in providing information access will continue to be problematic.

Technology

■ Technology will enable librarians to understand their users' needs better and to be more proactive in the delivery of relevant information, rather than the traditional model of users having to come to the library to find it.
■ Library portals will provide links to reliable resources, establishing quality standards for health information available to the public.
■ It will be commonplace for people to use more than one type of device to access information: desktop, personal digital assistant (PDA), tablet, cell phone.
■ There will be more mobile work within the library itself with wireless tools.
■ CD, DVD, and other formats will replace audiocassettes and videotapes and the equipment needed to use them, and the appropriate equipment needed to use them will be available in the library.
■ Facilitating access to the Internet and knowledge management tools will be a central mission of libraries.
■ Users will flock to wireless and mobile computing as it becomes more advantageous.
■ Use of small group interactive space in the library will lead to a desire for similar interaction across distance.
■ Most large medical centers will have developed a ubiquitous computing environment.

Other

■ All materials will not be available in electronic format, and the pricing for electronic access to some may be prohibitive.
■ Libraries will have quite varied uses based on the needs of each particular institution.