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# **Integrating Digital Reference Service into the Digital Library Environment**

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## **Abstract**

The difference between a digital library and a library with which a digital reference service is affiliated is discussed, and digital reference in these contexts is defined. There are several issues involved in integrating digital reference service into a digital library environment, but two that are unique to the intersection between digital libraries and digital reference: collection development of previously-answered questions, and presentation of specialized subsets of the materials in the digital library's collection. These two issues are explored.

## Introduction

Digital libraries have traditionally been defined primarily as collections of electronic resources, with little thought to services that may be offered to increase the usability of that collection. On the other hand, digital reference has traditionally been defined primarily as a service, with little thought to ways in which that service can contribute to and increase the value of a library collection. As both digital libraries and digital reference services mature, both are coming to realize the benefit of joining forces, integrating digital reference service into the digital library environment.

Physical libraries and desk reference services have been inseparable for well over a century. There can be little argument that a library's collection makes it possible to provide reference service, and that reference service increases the value of that collection for the library's patrons. Both digital libraries and digital reference are mature services in their own right: a number of technologies to support both of these services have developed and are continuing to evolve, and both have spawned well-established communities of research and practice. To date, however, these two mature services have matured independent of one another. As both digital libraries and digital reference services continue to evolve, it has become increasingly clear that, as physical libraries and desk reference services are necessary counterparts, each maximizing the utility of the other, so too digital libraries and digital reference services seem to be necessary counterparts. This whitepaper will explore the issue of integrating digital reference service into digital libraries.

Before any discussion of integrating digital reference service into a digital library can proceed, one point needs to be clarified: the difference between a digital library and a library with which a digital reference service is affiliated. This may seem an obvious distinction – but if it were indeed so, this paper would not be necessary. There is quite a bit of inconsistency in the literature concerning just what exactly both a digital library and digital reference is. Before this discussion can address integrating digital reference

into digital libraries, it is necessary to understand what is being proposed to be integrated into what.

## Digital Libraries Defined

Buckland (1992) makes a distinction between three types of libraries: the Paper, Automated, and Electronic Library (pp. 5-6). The distinction between these types of libraries rests on both the materials in the collection and the means by which technical services functions are performed: the Paper Library contains primarily a paper collection and is administered primarily via paper; the Automated Library contains primarily paper but administration is performed electronically; and in the Electronic Library both the collection and the administration are electronic. This distinction is shown in Table 1, reproduced from Buckland (p. 6).

**Table 1: Technological Bases of Library Operations and Materials**

	<b>Technical Operations</b>	<b>Library Materials</b>
<b>Paper Library</b>	Paper	Paper
<b>Automated Library</b>	Computer	Paper
<b>Electronic Library</b>	Computer	Electronic media

These days, most libraries in the developed world are automated libraries; more and more libraries are utilizing computing to perform technical services functions, but the primary collection of most libraries is still a print collection. Indeed, the paper library may be on its way to extinction in the developed world: few libraries these days do not offer at least electronic access to their catalog, and many libraries maintain digital collections – or at least access to others’ digital collections – in addition to their physical collections. On the other hand, the electronic library is yet to come: many libraries maintain digital collections, but there are few entirely-digital libraries, with no physical counterpart.

Buckland's (1992) distinction between types of libraries is according to the amount of technology used, and for what purpose. Greenstein and Thorin (2002) differentiate between types of digital libraries according to the age and sophistication of the digital library project. Greenstein and Thorin make a distinction between three types of digital libraries as well: the young, maturing, and adult digital library. The young digital library is just being launched, is in the planning and experimentation phase, and is "at some level deploying innovative technologies to deliver very traditional library services" (p. 4). While every digital library project develops differently, Greenstein and Thorin state that there are patterns to this development. The maturing digital library, then, is no longer as experimental as in its younger days, has "acquired core competencies and technical understanding" and is focused primarily on "integrating digital materials into the library's collections and on developing... the policies, technical capacities, and professional skills needed to sustain it" (p. 12). Greenstein and Thorin argue that all digital libraries currently in existence are of one of these two types; they claim that the adult digital library – one which is in no way "organizationally or functionally distinct from the library as whole" – has yet to arrive.

The difference – or lack thereof – between a digital collection and a digital library needs to be clarified at this point. A digital library might be taken to be equivalent with Buckland's electronic library: technical services performed electronically, and an entirely electronic collection. This, however, describes an extremely small set of libraries at this point in time. In practice, the term "digital library" is generally used synonymously with the term "digital collection," to describe any aggregation of electronic materials, whatever the format, and whatever the electronic materials' relationship to physical materials. Take, for example, some of the larger and older digital libraries: the Association for Computing Machinery's Digital Library (<http://www.acm.org/dl/>) is a collection of all ACM journals, magazines, and proceedings – a digitization of pre-existing print materials. The Perseus Digital Library (<http://www.perseus.tufts.edu/>) is actually a collection of several collections, and includes collections of texts (including transcriptions of papyri) and digitizations of maps, photographs, and other media. The Alexandria Digital Library Project (<http://www.alexandria.ucsb.edu/>) is based on existing

maps and geospatial information, but expands on those materials through the use of variety of media and technologies. The American Memory Project (<http://memory.loc.gov/>) contains electronic versions of materials in the Library of Congress archives. These collections 1) are all collections of electronic materials, 2) are all based, to differing degrees, in pre-existing physical media, 3) all refer to themselves as digital libraries.

The upshot is that there is no meaningful distinction between the terms “digital collection” and “digital library”: there are, at present, few exclusively electronic collections (that is, with no corresponding physical collection), and moreover, electronic collections based on physical collections are referred to as digital libraries. For the purposes of this paper, the terms “digital library” and “digital collection” will be treated as equivalent. The definition of the term digital library that will be employed in this paper is just this: a digital library is any collection of electronic resources, to which a patron can gain access electronically. A digital library may therefore be exclusively electronic, with no physical counterpart, or it may be a digital supplement to or extension of a physical library or library collection.

Levy and Marshall (1995) – presaging Greenstein and Thorin’s (2002) adult digital library – suggest that “the better word for these evolving institutions is ‘libraries,’ not ‘digital libraries’” (p. 83), since there is no function that a digital library serves that is not served by a physical library. Additionally, physical libraries have always contained information objects of a variety of media in their collections. Levy and Marshall suggest that the rise of digital libraries is simply the latest historical development in the several thousand year history of developments in libraries: the media in which information objects are stored and accessed is largely irrelevant; what fundamentally makes a library is the existence of both a collection and mechanisms for accessing that collection.

Borgman (1999) makes Levy and Marshall’s point for them – that there is no meaningful distinction between physical and digital libraries – by offering perhaps the broadest definition of the term “digital library” in the literature: she states that digital libraries are

(1) “a set of electronic resources and associated technical capabilities” (p. 234), that are (2) designed to serve a specific user community. Remove the word “electronic” from this definition, and Borgman could be describing a physical library – which is almost certainly Borgman’s point.

Additionally, Borgman (1999) raises an important point: the existence of a user community. All libraries serve a community of patrons: public libraries serve the local neighborhood, town, or city community; academic libraries serve the community of faculty, staff, and students of an educational institution; special libraries serve the community of employees and users of the organization of which they are a part. No library can be all things to all people; due to constraints on both physical space and budgets, a collection can only contain a finite amount of material, so any library must selectively choose what materials to acquire and maintain. Such decisions are performed “within the context of the institution’s missions and programs and the needs of the user populations served by the library” (Association for Library Collections & Technical Services, 2002, ¶ 2). This selective collection development is as true for digital libraries as for physical libraries. (The major difference between physical and digital libraries in this regard is that the “space” in which a digital library’s collection is stored is virtual and not physical space. A digital library has no concerns about the cost of shelf space – instead, a digital library must be concerned with the cost of disk space. Even digital collections are necessarily finite.)

## **Digital Reference Defined**

The foundations of modern reference work were laid by Samuel Swett Green in 1876 in his seminal essay, “Personal Relations between Librarians and Readers.” Since then, the practices involved in providing reference service have been refined, but there has never been much disagreement about the central purpose of reference service, which is to answer, and provide resources to enable patrons to answer their own questions.

In a physical library, reference question-answering is most often performed face-to-face, at a reference desk. Telephone reference has been offered for decades by many desk reference services, so a tradition of providing reference service in the absence of a face-to-face interaction with a patron is well established. In digital reference services, face-to-face service is obviously unfeasible (at least until videoconferencing starts being used in reference!). Early digital reference services discovered, however, as had telephone reference services, that face-to-face interaction is not necessary for answering patrons' questions; this function could be performed perfectly well in a mediated environment. Perhaps even more important than the existence of technological mediation, however, is the fact that many digital reference services utilize asynchronous communication media: early services were entirely email-based, while many services nowadays continue to utilize email, and additionally utilize the Web. Patrons may submit a question to an asynchronous service at any time, and that question can be answered when there is a librarian available to answer it.

Indeed, it did not take early digital reference services long to realize that there were decided advantages to asynchronous reference: specifically, that the librarian could take his or her time in composing a complete answer (rather than being held to an impatient patron's time constraints), and that the question could be forwarded to the individual best qualified to answer it (rather than the librarian who happened to be at the desk when the patron walked up).

In the early- to mid-1990s, reference services began to appear on the Internet that were not affiliated with a library, either physical or digital. Lankes (1998) refers to services of this type as "AskA" services, "such as Ask-A-Scientist" (p.9), since most services of this type specialize in a particular subject: for example, art (Ask Joan of Art), education (AskERIC), mathematics (Ask Dr. Math), oceanography (Ask Shamu), etc. AskA services are to desk reference services what digital libraries are to physical libraries: they more or less recreate the services offered by their physically-constrained cousins, but those services are offered primarily electronically.

Since the mid-1990s, a new type of reference service has begun to appear online: so-called “real-time” reference service. While more “traditional” digital reference makes use of asynchronous methods of communication, real-time reference makes use of synchronous methods of communication: chat environments, instant messaging, and graphical co-browsing. Prior to the development of these technologies, synchronous computer-mediated reference had been experimented with in MUD and MOO environments.

The purpose in providing this history is to illustrate the fact that digital reference has many faces: synchronous and asynchronous, affiliated with a library and standalone, utilizing a variety of different technologies. The common thread tying these diverse types of services together is that they all employ computer-mediated forms of communication to both receive questions and provide answers. This fact provides the definition of the term “digital reference” that will be employed in this paper: digital reference is a service that provides users with answers to questions in a computer-mediated environment.

The purpose of these opening sections was to clarify the difference between a digital library and a library with which a digital reference service is affiliated. This can now be accomplished. A digital library, as stated above, is any collection of electronic resources, to which a patron can gain access electronically. A digital reference service provides users with answers to questions in a computer-mediated environment. The upshot is that there is no meaningful difference between a digital library and a library with which a digital reference service is affiliated, except insofar as there is a difference between a digital and a physical library. Some physical libraries have affiliated digital reference services, and some of these physical libraries also maintain digital collections. There is no reason why a digital reference service could not be affiliated with an entirely digital library (Buckland’s Electronic Library). Thus, digital libraries and digital reference services are two separate entities, and the existence of one has no necessary impact on the existence on the other. In this way, digital libraries and digital reference services are like physical libraries and desk reference services – few physical libraries are without a reference desk, but such a library could conceivably exist with no detriment to the library

(the detriment would be to the patron). Similarly, while desk reference services are traditionally thought of as being subsumed within physical libraries, reference-like services exist in many other contexts – help desks, information and referral services, etc. – and are therefore not confined to the library environment.

Thus, this paper, in proposing the integration of digital reference into digital libraries, is making only a small stretch from the history (or histories) of libraries and reference. Physical reference services are integrated into physical libraries, and digital reference services are similarly integrated into physical libraries. While digital reference services have not been integrated into digital libraries, there is no reason – either technological or historical – why it would not be possible, even logical to do so. This is entirely in keeping with Levy and Marshall’s (1995) suggestion that digital libraries are simply a new form of libraries. Viewed in that light, the integration of digital reference into digital libraries is a logical and natural step in the evolution of both services.

## **The State of the Art**

It is unclear how many digital reference services exist. The Virtual Reference Desk Project maintains a list of AskA services called the “AskA+ Locator” (<http://www.vrd.org/locator/subject.shtml>), which, as of this writing, contains over one hundred services. Bernie Sloan maintains a list on his personal website of over 90 email-based reference services offered by public and academic libraries (<http://www.lis.uiuc.edu/~b-sloan/e-mail.html>). It is important to note, however, that neither of these lists claims to be comprehensive, and it is impossible to know how many services are *not* listed. White (2001) found that 45% of libraries at institutions categorized as Master’s (Comprehensive) Universities and Colleges I and II by the Carnegie Foundation for the Advancement of Teaching offered either email- or webform-based digital reference service (p.175). Two years previously, Goetsch, Sowers, and Todd (1999) had found that 96% of Association of Research Libraries (ARL) members’ libraries offered electronic reference. These two examples surveyed highly constrained populations, and again, it is impossible to know how many services were not surveyed.

One's sense, however, is that most libraries in the United States these days – public and academic, with or without digital collections – have an affiliated digital reference service.

Most digital libraries, on the other hand, are not making any effort to incorporate reference service. Some digital libraries have a collection of documentation and other help materials, and some even have a help desk staffed by humans, generally to answer technical questions about the use of the collection. Neither of these, however, rises to the level of a reference service – the purpose of which is to answer users' content-related questions using materials from the collection. Indeed, the Institute of Museum and Library Services' (IMLS) document "A Framework of Guidance for Building Good Digital Collections," states explicitly that "services have been deliberately excluded as out of scope" (IMLS, 2001, INTRODUCTION section, ¶ 4) of the discussion of building good collections.

The IMLS Framework document goes on to state, however, that "it is expected that if quality collections, objects and metadata are created, it will be possible for any number of higher level services to make use of these entities" (IMLS, 2001, INTRODUCTION section, ¶ 4). The National Science, Mathematics, Engineering, and Technology Education Digital Library (NSDL) (<http://www.ehr.nsf.gov/ehr/DUE/programs/nsdl/>) utilizes the IMLS Framework to guide best practices for the NSDL's collections. And, in keeping with the call for "higher level services," one of three tracks in the NSDL initiative is the Services track. The goal of this track is to "increase the impact, reach, efficiency, and value of the digital library" (Directorate for Education and Human Resources Division of Undergraduate Education, 2002, p. 6) through the development of services in support of both users and collection providers.

The author is currently involved in a project at the Information Institute of Syracuse at Syracuse University entitled "Integrating Expertise into the NSDL: Putting a Human Face on the Digital Library," funded under the precursor to this NSDL initiative, NSF grant 01-55. The objective of this project is twofold: 1) to build an operational digital reference service to support the NSDL, and 2) to conduct research into creating a more

effective digital library service through the integration of reference services into digital library collections.

Many of the other projects funded under NSF grant 01-55 are concerned with building collections in specialized subject areas (e.g., Biology, Earth Systems, Health Education), or exploring ways of integrating various practices or technologies into collections (e.g., generation of metadata for collection materials, peer review of collection materials).

These projects are on the cutting edge of digital libraries: they are integrating various forms of multimedia into collections, they are developing new ways to create, organize, and access content, and they are developing innovative practices for managing that content. The work being done as part of the “Integrating Expertise into the NSDL” project, when the NSDL is launched, will increase the usefulness of these collections and the innovative work that is being done as part of those projects, by making use of human intermediation. Indeed, the “Integrating Expertise into the NSDL” project attempts to emulate the practice of physical libraries, which have historically had the goal of increasing the value of their collection through human intermediation.

## **Issues Involved in Integrating Digital Reference Service into a Digital Library Environment**

In the course of working on the “Integrating Expertise into the NSDL” project, we have discovered that there are several issues involved in integrating digital reference service into a digital library environment. These issues may be divided along two dimensions: first, those issues that are unique to the situation of a digital reference service in a digital library environment, and those that are applicable to digital reference service in general. The second dimension along which these issues can be divided are those issues that are unique to the situation of a reference service in an electronic environment (though not necessarily a digital library environment), and those that are carry-overs of issues from the world of physical reference services.

The first of these “carry-over” issues is that of expertise: who should be allowed to be an “expert” and to answer questions. In the arena of desk reference services this issue has generally been couched as one of credentials: should only professionally trained librarians be allowed to provide reference service, or should paraprofessionals be allowed to provide some services? Whitson (1995) presents this distinction as one of “differentiated” versus “undifferentiated” service: undifferentiated service assumes that any individual providing reference service can perform any task and answer any question – thus requiring that all reference librarians be highly trained. Differentiated service, on the other hand, allows for different individuals to perform different tasks in the reference process – thus allowing professional librarians to perform the more complex tasks and answer the more difficult questions, while paraprofessionals may perform those tasks that require less professional training. While some of the tasks may be different in a digital reference service than in desk reference (McClennen and Memmott, 2001), the same issue exists of who is the most appropriate individual to perform any given task.

A closely related issue to that of expertise and credentials is the issue of: expertise in what? Ferguson and Bunge (1997) state that the “traditional” reference desk is staffed by reference experts – as opposed to subject experts (p. 255-6). This practice probably evolved due to the immediacy of the reference transaction at a reference desk: a patron may approach the desk with any question, and with time constraints to boot, so it is necessary that the librarian at the desk be able to answer any question relatively quickly. As mentioned above, this requires that all reference librarians be professionally-trained reference experts. Particularly in public or academic libraries it is not feasible that a subject expert routinely staff a reference desk, as it cannot be assumed that patrons will approach the desk with questions within that subject area. In special libraries, such as law or medical libraries, it is more reasonable to assume that patrons’ questions will fall within particular subject areas. Still, even in special libraries, the librarians staffing the reference desk are generally professionally-trained reference experts, with a subject specialization. In an asynchronous digital reference service, on the other hand, it is more feasible to have subject experts answering patrons’ questions – not only reference experts with subject specializations, but experts in specific subject areas: physicists,

volcanologists, oceanographers, educators, artists, you name it. This is truly Whitson's (1995) notion of differentiated service: who could be more appropriate to answer a question on, say, oceanography than an oceanographer? Sadly, just as not every subject expert is a good teacher, not every subject expert is likely to be a good reference provider. Thus, a balance must be struck between the use of reference and subject experts to answer patrons' questions.

A third issue that has carried over from the world of physical reference services is that of referrals: under what circumstances should one digital reference service forward a question to another? Desk reference services have always received questions that are outside their scope of service. Rather than simply turn a patron away without an answer, reference librarians will often refer the patron to another reference service or organization for which the question is in scope. This situation is no different in an electronic environment: digital reference services also receive questions that are outside their scope of service, and they may refer a patron to another service or organization. The difference between referrals from a desk reference service and from a digital reference service is who has the responsibility for completing the referral. In desk reference, if a patron is referred from one service to another, the burden is generally on the patron to contact that other service. In digital reference, on the other hand, if a referral is made, it is not the patron who is sent from one service to another, but the patron's question. Thus, the burden is on the service that received the question from the patron to perform the referral, and on both services to work out the details of the exchange.

It is in the details of the exchange of a question that the issue of referrals takes on an aspect unique to the situation of a reference service in an electronic environment. In the electronic environment, forwarding a question from one digital reference service to another is technically simple; every email application has a Forward button and an addressbook. What is more complex is developing policies and standards to govern the making of referrals. Such policies are discussed in depth by Jo Bell Whitlatch in her whitepaper in this volume, and so will not be discussed further here. Lankes (1999) describes the Question Interchange Profile (QuIP), a proposed standard for passing

additional information between digital reference services along with a question: information about the patron, about the forwarding service, etc. Formalization of such a standard is currently being carried out by the National Information Standards Organization (NISO) Networked Reference Services Standards Committee AZ ([http://www.niso.org/committees/committee\\_az.html](http://www.niso.org/committees/committee_az.html)). The challenge of developing standards for networks of collaborating digital reference services is discussed in depth by Michael McClennen in his whitepaper in this volume, and so will not be discussed further here.

Another issue unique to the situation of a reference service in an electronic environment is that of automation: which processes involved in providing digital reference service may be and which should be automated? One of the processes for which automation has been employed is that of forwarding questions between digital reference services, and to the appropriate expert within a service, called “triage” (Lankes, 1998; Pomerantz, Nicholson, and Lankes, forthcoming). Kresh (2000) describes the Collaborative Digital Reference Service (CDRS, now called QuestionPoint), which utilizes a software algorithm to triage questions to participating digital reference services, by matching questions with the most appropriate service, based on profiles of the participating services. Another process for which automation has been employed is that of question-answering. Bry (2000) describes the Mad Scientist Network (MADSci), which utilizes a CGI script to search the MADSci archives of previously-answered questions for potential answers to users’ submitted questions. Both QuestionPoint’s and MADSci’s automation, however, are in the early stages of development: QuestionPoint’s profiles of participating services only contain a few criteria, including hours of service, subject strengths and scope of collections, and types of patrons served [How Does CDRS Work section, ¶ 2], and so the triage algorithm can only match questions with services based on these few criteria. MADSci’s question-answering algorithm matches “approximately 63 percent of questions... with archived files” – however, “only 25 percent of users deem their questions answered by this process (15 percent of all submitted questions)” (p.118). The automation of triage and question-answering will require some improvement before it is likely to be widely adopted. Additionally, triage and question-answering are only two

processes out of the many involved in providing digital reference service. It is possible that other processes may be amenable to automation as well, for which automation has not yet been attempted. Further research and development of algorithms is required to push this automation forward.

The final issue that will be addressed in this section is one that is a carry-over from the world of physical reference services – but also from the world of physical libraries in general. This issue is that of serving audiences that are not the primary patron community of a library or reference service. Libraries and reference services have always, to a greater or lesser degree, served non-primary patron communities. Especially in public libraries, one never knows who will come in and want to use the library's resources. Even academic and special libraries, which may not grant physical access to unaffiliated individuals, may still receive telephone calls or emails from individuals outside the organization. This is even more of an issue for digital reference services, as users have easy access to services with which they are not affiliated via the Internet – indeed, it may be no more difficult for a user to access a remote library's digital reference service than it is to access a local service. Silverstein and Lankes (1999) describe four sets of audiences and users that may wish to gain access to a library's resources:

- Core users are familiar with a specific resource.
- Secondary audiences have great knowledge of an agency's scope, but are unfamiliar with a given resource.
- Topical users are familiar with an agency's topic on a broad scale, and
- General users are the general public with minimal understanding of the agency or its resources.

Lankes argues that as Internet adoption has increased, the number of secondary, topical, and general users seeking access to all organizations' resources has correspondingly increased. But these users' increased access to the resources of digital reference services is especially taxing on those resources, as one of the primary resources provided by digital reference services is human intermediation. The increase in the number of secondary, topical, and general users seeking access to the resources provided by digital

reference services gives new life to the old question faced by physical libraries and reference services: how much resources should be allocated to supporting patrons from these non-primary communities? This is another policy that must be decided upon to govern the operation of the digital reference service and/or digital library.

**Table 2: Issues Involved in Integrating Digital Reference Service into a Digital Library Environment**

	<b>Carry-overs from physical reference</b>	<b>Unique to an electronic environment</b>
<b>Applies to digital reference service in general</b>	<ul style="list-style-type: none"> <li>• Expertise and credentials</li> <li>• Reference vs. subject expertise</li> <li>• Referrals</li> </ul>	<ul style="list-style-type: none"> <li>• Policies and standards to govern referrals</li> <li>• Automation</li> </ul>
<b>Unique to digital reference service in a digital library environment</b>	<ul style="list-style-type: none"> <li>• Serving non-primary patron communities</li> </ul>	<ul style="list-style-type: none"> <li>• Collection development</li> <li>• Creation of resource collections</li> </ul>

Table 2 presents the issues involved in integrating digital reference service into a digital library environment, along the two dimensions presented above. The issues in the three shaded cells have been discussed in this section. These issues are important in the integration of digital reference service into a digital library environment, as well as to the operation of a digital reference service in general, regardless of its affiliation with a digital library. There are, however, two issues – listed in the unshaded cell – that are unique to the intersection of digital libraries and digital reference service: the issues of collection development and the creation of resource collections. These issues, taken in a broad sense, are universal to libraries of all types, digital and physical. However, for the integration of digital reference service into a digital library, these two issues take on unique aspects. The rest of this paper is a discussion of the unique aspects of these issues.

## ***Collection Development***

One of the most important tasks undertaken in any library – physical or digital – is collection development, for without a collection there is no library. As McColvin (1925) states in his classic text on collection development, “book selection is the first task of librarianship... the ultimate value of a library depends upon the way in which the stock has been selected” (p. 9). Of course, collection development in a digital library is not primarily concerned with book selection, but rather with the selection of both physical items to digitize and “born-digital” materials in any number of electronic formats. The point remains valid, however, that the value of a library is the value of the materials in its collection. Replace the word “book” with the word “material” or “resource,” and McColvin’s quote is as accurate today as the day it was written. McColvin might have said that a library’s collection is the sum total of that library’s book holdings; a more modern definition, however, is that a library’s collection is the sum total of that library’s holdings of materials in any media format.

The value of a library – physical or digital – may take any or all of several forms: economic, moral, philosophical, etc. Additionally, this value may be different for different patron communities and purposes that the library serves. The assignment of value is complex in many ways, but such assignment is not the concern here. Let it simply be acknowledged that libraries have value, in a variety of forms, and that that value (or those values) is both determined and created by the library’s patron community.

As McColvin (1925) states, one of the factors that most directly determines the value of a library – value in all its forms – for a library’s patron community is the library’s collection. And the library’s collection is directly determined by the library’s collection development policies. Every library develops a collection development policy that guides the selection of materials in the library’s collection. Collection development policies codify 1) the scope and maintenance of the collection, 2) the ways in which the collection should contribute to the mission of the organization of which they are a part, and 3) the

scope of the patron community(-ies) of the library, and the utility of the collection for the library's patrons.

### ***Collection Development in Digital Libraries***

Collection development policies are as important to digital libraries as they are to physical libraries, a fact that is acknowledged in the IMLS Framework:

Collections principle 1: A good digital collection is created according to an explicit collection development policy that has been agreed upon and documented before digitization begins.  
(IMLS, 2001, COLLECTIONS section, ¶ 2)

Note that this definition assumes that a collection is developed through digitization – that is, through the creation of electronic versions of physical materials. A more inclusive definition of a digital library's collection would include the selection of “born-digital” materials.

That said, the IMLS Framework (IMLS, 2001) then goes on to describe how a digital library's collection development policy should address the three purposes, mentioned above, that any collection development policy must fulfill.

In the past, digital libraries – “young” digital libraries, at any rate – have been concerned only with the mission of the organization of which they are a part. Young digital libraries, according to Greenstein and Thorin (2002), experiment with different technologies in an attempt to better support the mission of the organization through technology. As services come to be increasingly of concern to digital libraries, however, there is a correspondingly greater concern with the needs of the library's user community. As a digital library matures, it “seems to rediscover users. ... As the integration of new technologies begins to transform the library and the possibilities for constructing

innovative networked services, libraries see a pressing need to engage users and to reassess their interests and needs” (Greenstein and Thorin, 2002, p. 14).

Indeed, a digital library is in many ways like an academic or a special library, in that its primary patron community is fairly well defined. While public libraries are by definition public, and therefore serve a heterogeneous patron community, an academic library, for example, serves a reasonably well-defined community of scholars and students in their research and studies. Special libraries also serve a specific user community within an organization and build collections relevant to that community. Similarly, the specific patron community that a digital library is designed to serve is often fairly well defined. For example, the Association for Computing Machinery’s Digital Library is available only to ACM members, database subscribers, and individuals affiliated with organizations that maintain a subscription. The Alexandria Digital Library, on the other hand, is freely available to the public but is in fact probably used primarily by those with an interest in the fairly narrow domain of geospatial information. These, like many other digital libraries have to date concentrated on supporting the mission of the organization through serving their primary user community. As these digital libraries have matured, however, they have begun to more deliberately engage users: the ACM digital library, for example, has introduced, among other things, *The Bookshelf*, a service for creating custom collections, and *DL Pearls*, “a monthly column that will help you get the most out of the vast resources contained in the ACM Digital Library” (<http://portal.acm.org/dlpearls/dlpearls.cfm>).

Another service that a digital library may offer is to provide reference service. Indeed, Greenstein and Thorin (2002) might argue that it took physical libraries many centuries to move from being “young” to being “maturing” – while other user services may have a longer history, it is generally acknowledged, as mentioned above, that reference service as we know it today dates back to 1876 and Samuel Swett Green. It has taken digital libraries far less time to begin to offer reference services.

## ***The Special Collection***

In a physical library, the reference department usually has its own special collection, a subset of the collection in the whole library. Reference collections generally consist of two parts: the entire reference collection, and the ready reference collection – a subset of the entire reference collection, consisting of those information resources most frequently used at the reference desk. The relationship between all of these collections is represented in Figure 1.



**Figure 1: Library Collections**

Digital libraries – like physical libraries – are dependent on their ability to be searched effectively by the patron. Physical libraries organize information resources on the shelves according to some classification scheme, and provide a catalog (an OPAC or card catalog) as the interface through which the patron can match his or her information need with the library’s organizational scheme. In a digital library, however, the organizational infrastructure is more or less hidden from the user (regardless of whether that user is a

patron or a librarian), so there is no need for the two-step process necessary in physical libraries, in which the patron must first determine the unique identifier of an information resource (the call number), and using that identifier may then find the resource itself. Instead, a search of a digital library can provide the user with a citation and a link directly to an information resource (as in a search engine), or with the actual resource itself (as in a full-text database).

In a reference service affiliated with a digital library, therefore, there may not be any need for separate reference or ready reference collections. Desk reference services maintain reference collections because it is unfeasible for a reference librarian to make use of the library's entire collection when performing reference work – and the larger the library, the more this is the case. In a digital library, however, no information resource is any more or less accessible than any other. In effect, the entire collection in a digital library may be considered to be the reference collection. All information resources are equally accessible; it is not necessary to separate out the most frequently used resources. Every information resource is a reference source.

On the other hand, it may be desirable not to separate out, but to gather together in some way frequently used or popular resources from the digital library's collection at large. One of the primary reasons that a physical library's ready reference collection is separated out from the rest of the collection is because it is more convenient for reference librarians to have certain resources at their fingertips, physically nearby. Similarly, some digital libraries maintain collections of related resources for ease of access. The Internet Public Library (IPL), for example, maintains a list of "Subject Collections" on topics presumably commonly asked of the service (<http://www.ipl.org/div/subject/>). The Perseus Digital Library, for another example, maintains an "exhibit" on Hercules (<http://www.perseus.tufts.edu/Herakles/>) and another on the ancient Olympics (<http://www.perseus.tufts.edu/Olympics/>). At the time of this writing, the American Memory Project was featuring a collection on the origins of American animation (<http://memory.loc.gov/ammem/oahtml/>). In this way, it is possible for a digital library to create a special collection, simply by providing easy access to a select subset of the

resources in the collection – putting resources at users’ fingertips, metaphorically “nearby.” Indeed, any number of such special collections may be created by “slicing” the entire collection in a variety of ways. These special collections may also change over time, based on trends in the resources in the collection that are frequently accessed, current hot topics, or any number of other criteria.

The creation of such special collections is one more service that digital libraries may offer in order to engage users. In a digital library offering reference service, one user population that must be engaged is the population of reference librarians. From a certain point of view, reference collections are simply a special case of special collections: a special collection is a specialized subset of the materials in a library’s entire collection, and a reference collection is one such possible subset. The primary user community for a reference collection is reference librarians, and the purpose of a reference collection is to make a certain body of information and set of information resources available. The primary user community and purpose of a special collection depends on the nature of the materials in the collection and the policies of the library – some special collections may be in circulation, and some may be in archives and inaccessible to the casual user. In a digital library, however, there is no concern with materials becoming worn or ruined through circulation, and therefore all materials may be made accessible to all users. Due to this difference between physical and digital special collections, the term “resource collections” will be used from here on to refer to special collections of materials in a digital library.

One of the most important tasks of digital reference service – indeed of any reference service, digital or physical – in order to provide useful and timely information to the patron, is to provide access to the material in the collection in ways that are appropriate to the patron’s particular needs. There are two ways in which this can be done: proactively and responsively. Creating resource collections responsively may be the easier of these two. Trends in the questions received by the digital reference service may be tracked, so that frequently asked questions and “hot topics” may be discovered, and resource collections created to meet the information needs that gave rise to those trends.

On the other hand, it is possible, to a certain extent, to anticipate patrons' information needs. For example, it's reasonable to assume that a certain percentage of the Internet-using public would be interested in the ancient Olympic games, during the modern Olympics, and would go to the Perseus Digital Library – a digital library that has a particularly strong collection of material on Greek and Roman history – to find information on that topic. And indeed, the Perseus Digital Library made an “exhibit” on the ancient Olympics available around the time of the 1996 games in Atlanta, Georgia. For another example, as I write this it is September 11, 2002, and the American Memory Project has dedicated their Today in History page (<http://memory.loc.gov/ammem/today/>) – which usually presents events that happened at least twenty-five years in the past – to the events of and commentary on September 11, 2001 – a topic on which there is certainly a great deal of interest.

It behooves any digital reference service to get to know its patron community – core through general users – and the information needs of that patron community. Indeed, knowing the community of users of the library and the requirements of that community is one of the first tenets of collection development. And, knowing that community, resource collections can be created to meet specific information needs, just as the collection as a whole is developed to support the needs and uses of the community.

### ***The Reference Transaction as Information Resource***

There is a long tradition of capturing statistics at desk reference services, as a means for evaluating the reference transaction. Often these statistics are nothing more complex than tick marks on a reference transaction slip. A great many forms exist for capturing data about the desk reference transaction, however, and a great many variables and statistics have been utilized in analyzing the reference transaction (Crews, 1988; Saxton, 1997). Still, even the best reference evaluation form does not capture the actual reference transaction, merely a thin representation – and worse still, as such forms are generally

filled out after the transaction is completed, frequently based on the librarian's reconstruction of the transaction.

It took the digital reference community no time at all to realize that this was a problem that simply didn't exist any more – the nature of electronic media allowed the *entire* reference transaction to be captured, verbatim, and completely unobtrusively. The transaction itself, conducted electronically, creates an artifact that may be stored until deliberately deleted. For example, an email-based transaction may create a “thread” of email messages that may be associated through the Subject line, while chat-based transactions may create a log containing the entire conversation. This simple fact has two important implications. First is that the reference transaction, once captured, may itself be utilized as an information resource. Second is that the reference transaction may become in effect an annotation to any information resource that it refers to. This section will address the first implication; the second implication will be addressed below.

In digital reference services affiliated with a physical library, collection development works just the same as in any library: the fact that a physical library offers digital reference service does not necessarily have any effect on the library's collection development policies. The library presumably continues to acquire materials that support the needs and uses of their patron community. These acquisition decisions presumably continue to be made by an acquisitions department, constrained by budgetary limits and other practical considerations.

In digital reference services unaffiliated with a physical library, however (as well as in those affiliated with a physical library, above and beyond their physical collection) a collection can be developed directly in response to patrons' questions. A recent study performed by Pomerantz et al. (under review) found that 42% of digital reference services surveyed store question-answer pairs in a database or other archive. Thus, a service's experts may have access to an ever-growing pool of previously-answered questions when working on an answer to a new question. Some digital reference services even make this archive publicly available – as, for example, does the MadSci Network

(<http://www.madsci.org>) – thus in effect treating the archive of previously-answered questions as a collection like any other. (Such collection of patrons' questions raises obvious privacy issues, such as whether or not to strip any information that could potentially identify the patron out of the question-and-answer pair. The issue of privacy as a matter of policy is discussed by Jo Bell Whitlatch in her whitepaper in this volume, and so will not be discussed further here.)

In developing such a collection, digital reference services turn the traditional relationship between collection development and reference service on its head. Physical libraries traditionally have been built around a collection or collections, to which reference has been one way of providing an interface. While reference has been an important component of physical libraries, it is not a component without which the collection would cease to exist or grow. In digital reference services that archive previously-answered questions, on the other hand, this collection is itself a result of, and could not exist without the service. Thus, instead of providing an interface to a collection, the digital reference service becomes the source of the collection.

There are at least two ways in which the digital library's collection can grow as a result of archiving the reference transaction: through deliberate collection development, and through incidental "accretion." Deliberate collection development might proceed like this: one step in the digital reference process, according to Lankes (1998) is the tracking of data about questions that are received by the service, looking for trends and "hot topics." By tracking trends, it might become clear that patrons are asking questions about, for example, amphibians, but the digital library's collection does not have many resources on amphibians. It therefore becomes clear (assuming that amphibians are within the digital library's scope) that the digital library must build up its collection of resources on amphibians. This may then be done deliberately by the digital library's collection development staff.

On the other hand, the incidental accretion of materials might proceed like this: a patron asks a question about, for example, cows. In formulating an answer to this question, the

librarian scans, say, some photos of different breeds of cows, and a document about animal husbandry (in accordance with fair use, naturally). If they were not previously, these resources are now part of the digital library's collection, as the reference transaction is archived and part of the collection. Thus, over time, materials "accrete" due to the fact that they are part of reference transactions. This form of collection development is the result of a deliberate collection development decision, but is rather a result of demand by patrons for information on specific topics. Librarians must be careful, however, to make sure that any materials that they add to the collection are within the digital library's scope of service. Even for this accretion of materials, which is only an incidental addition of materials to the collection, a collection development policy must be developed. And again, the traditional relationship between collection development and reference service is turned on its head, as reference librarians become collection developers.

### ***Collection Development of Previously-Answered Questions***

As discussed above, in a digital library every information resource is a reference source. And in a digital library in which previously-answered questions are archived and made available to librarians and patrons, the reference transaction is itself an information resource. The question is, is the reference transaction an information resource of the same sort as the main collection? Put differently, should the reference transaction be included in the digital library's collection, or should the archive of previously-answered questions be a collection of its own, auxiliary to the main collection?

According to Levy and Marshal (1995), there is nothing privileged about any materials in a digital library's collection (or indeed in any library's collection): library collections have always contained materials of many different formats, and those materials change over time. This would seem to be an argument for including the reference transaction in the main collection, as doing so would be consistent with the multiplicity of formats and lifespans of materials in a digital library's collections. On the other hand, including the reference transaction in the main collection runs contrary to the general practice of existing digital reference services which maintain collections of some sort: most such

services maintain their archive of previously-answered questions separate from their main collection. The AskERIC service, for example, provides access to the ERIC database (<http://www.askeric.org/Eric/>), and maintains a separate archive of questions commonly asked of the service (<http://www.askeric.org/Virtual/Qa/archives/>). There is a clear distinction between the materials in the ERIC database and the questions that have been answered by AskERIC.

Should the scope of the ERIC database be altered to encompass question-and-answer pairs? Probably not, as the scope of the ERIC database is “abstracts of documents and journal articles on education research and practice” (<http://www.askeric.org/Eric/>), and not questions and answers about education research and practice. This, however, is a deliberate decision made by those responsible for collection development for the ERIC database. This question generalizes to all digital libraries, however: should the scope of a digital library collection encompass question-and-answer pairs? The answer to this question is a decision that must be made deliberately and as a matter of policy by those responsible for collection development.

One unique feature of collection development decisions in a digital library is that there is no necessary separation between any two “locations” in an electronic environment. This is, in fact, part of the problem that has led to the long debate concerning the copyright issues involved in hyperlinking, started so dramatically by the 1997 case *Shetland Times Ltd. v. Wills* (<http://www.jmls.edu/cyber/cases/shetld1.html>), in which the Scottish newspaper *The Shetland Times* sued another newspaper, *The Shetland News*, to prevent that paper’s “deep linking” to the Times’ website, and – according to the Times – presenting content created by the Times as its own. The fundamental problem in this case was that it can be difficult to tell when following a link has caused one to leave one site and brought one to a different site, thus sometimes making it appear (especially in a framed environment) as if the content from one site belongs to another.

The fact that there is no necessary separation between any two “locations” in an electronic environment means that any separation of a digital library’s main collection

and a collection of previously-answered questions is purely artificial, the result of the presentation of these two collections. The Shetland Times case made this point about content on two different sites, maintained by two different organizations, but the same is true of content on one site: any separation of “collections” is purely in the design of the website. As mentioned above, AskERIC separates the ERIC database and its list of frequently-asked questions, and this is accomplished by locating the links to these two collections under different menus on their website. Both collections are searchable, however, and a different design decision could have made both collections searchable via one interface.

Indeed, within the AskERIC Question Archive (<http://askeric.org/Virtual/Qa/archives/>), there are fourteen categories top-level categories, with many sub-categories on which previously-answered questions have been collected. AskERIC has created a set of resource collections on a variety of topics, simply by “slicing” their collection of previously-answered questions in a variety of ways. And these resource collections may change over time as new trends in the questions received by AskERIC are tracked.

In summary, the scope of the digital library’s collection is a decision that must be made by those responsible for development of the collection. Part and parcel of this decision is the issue of whether or not to include previously-answered questions in the collection. A subsequent decision, then, is how to present the materials in the collection or collections. Both of these decisions may include those responsible for collection development, the reference staff, and website designers.

### ***The Reference Transaction as Annotation***

It was mentioned above that in an electronic environment the entire reference transaction can be captured verbatim. The second important implication of this fact is that the reference transaction may become in effect an annotation to any information resource that it refers to. For example, a user of a digital reference service may ask a question about astronomy, and the reference or subject expert who answers the user’s question may

provide citations for or links to information resources on astronomy. The reference transaction thus contains “pointers” to those particular information resources. Depending on whether the expert has said good or bad things about those information resources, that pointer may be for better or for worse (though of course reference experts generally only provide worthwhile information resources, and only rarely provide outstanding negative examples).

This notion of pointers to information resources is, in fact, the principle on which the Google search engine works. The principle behind Google is that of “hubs” and “authorities”: authority documents are those that point to other documents, and hub documents are those that are pointed to by authorities. (Of course, in a hypertext environment such as the Web, a document may be both a hub and an authority.) The secret of Google’s success is that it ranks authorities, so that a pointer to a document from an “A list” authority, as it were, is more heavily weighted than a pointer from a “B list” authority. When a list of retrieved hits is displayed after a search, the hub webpages with the greatest scores, based on the weights of the authorities that point to them, appear at the top of the list of retrieved hits – thus insuring that the webpages most linked to from “A list” authorities appear at the top of the stack (Brin and Page, 1998). (For the moment let us ignore that Google, like so many search engines these days, also sells their rankings, so that for a price one can be insured of being listed at the top of the list of retrieved hits (<http://www.google.com/ads/overview.html>).

While information resources in a digital library or a digital reference environment have not, to the author’s knowledge, ever been treated as hubs and authorities, it is certainly possible to imagine it being done. It would be possible in this way to build a collection of the most popular information resources in a collection, simply by “harvesting” the resources in the collection to which the greatest number of answered reference questions point – even ignoring the additional possibility of weighting these authorities. (Again, it is of course not possible to know whether an information resource is being referred to positively or negatively. As all academics know, one way to get cited is to be disagreed with.)

Some websites do something similar to this already, by making available a list of the most heavily accessed webpages on the site. This is fairly simple to do by analyzing the website's logs. This practice, however, raises an interesting distinction. There are two ways to determine what the most popular or useful information resources in a digital library or a digital reference environment may be: those resources pointed to by reference or subject experts, and those accessed by users. These may not be at all the same; as any librarian knows, the materials most commonly used by librarians are not the materials with the heaviest circulation among library patrons, and vice versa.

Reference transactions may thus be viewed as annotations to the information resources in the collection to which they are pointing. For example, a patron's question about astronomy is answered using documents A, B, and C in the collection. Another patron's question about the astronomer Edwin Hubble is answered using documents B, D, and E. Clearly, document B contains information useful for answering questions both about astronomy in general and about one specific astronomer. Over time, as reference transactions are archived, each information resource in the collection will develop a "profile," as it were: a collection of usage data from which it can be determined what types of questions, or what information needs a resource may be used to answer. Moreover, this profile will be the result of expert knowledge – what resources subject or reference experts have provided to answer specific questions. This profile is metadata about the document, and as such can be used for all of the purposes for which metadata is used: for organizing the materials in the collection, for standardizing the exchange of resources between collections, by information retrieval algorithms to rank a document in a list of retrieved search results, etc.

## **Conclusion**

Both digital libraries and digital reference services are complex entities, with which a number of issues are associated. These issues may be divided along two dimensions:

1. Those issues that are unique to the situation of a digital reference service in a digital library environment, and those that are applicable to digital reference service in general, and
2. Those issues that are unique to the situation of a reference service in an electronic environment, and those that are carry-overs of issues from the world of physical reference services.

Out of these issues come a number of decisions – policy, standardization, technical, etc. – that must be made in order to set up and manage them and the services associated with them.

There are, however, two issues that are unique to the intersection between digital libraries and digital reference. These issues, while universal to libraries of all types, digital and physical, take on unique aspects for the integration of digital reference service into a digital library environment. These two issues are:

1. Collection development of previously-answered questions and any supplementary materials that are included in the answers to questions, and
2. Presentation of “resource collections” – specialized subsets of the materials in the digital library’s entire collection.

Underlying the former issue is the process of annotation: as questions are answered using the materials in a digital library’s collection, those answers become annotations to those materials. The nature of the electronic medium is such that previously-answered questions may become documents and be archived as information resources in their own right. The existence of these annotations as information resources gives rise to the following collection development question: do these annotations become a collection in their own right? Additionally, if in answering a question a reference librarian uses an information resource that was not in the digital library’s collection – by scanning it, say – does that resource become part of the collection? These are decisions that affect the nature, content, and growth of the digital library collection, and therefore must be set by collection development policies for the digital library. If the digital library’s collection

development policy is to collect these annotations and supplementary materials, then there is another policy question that immediately follows: should these annotations be made available to the digital library-using public, or only to the reference staff affiliated with the library?

Underlying the latter issue is the presentation of materials in the digital library's collection to the patron: in an electronic collection no information resource is any more or less accessible than any other. Digital reference services have taken advantage of this by creating resource collections based on a variety of criteria: hot topics, frequently-asked questions or frequently-used materials, etc. The fundamental issue here is how to create these resource collections. They must be created both responsively and proactively. Trends in the questions received by the digital library must be tracked, so that trends and "hot topics" may be discovered, and resource collections created to meet the information needs that gave rise to those trends. Additionally, the information needs of the digital library's patron community must be understood, so that resource collections can be created to meet those needs ahead of time.

Both of these issues – collection development and presentation of resource collections – involve decisions that must be made on a case-by-case basis, by each digital library and its associated digital reference service. As digital libraries increasingly come to have digital reference services affiliated with them, best practices will emerge in collection development and website design for different types of digital library collections, and different scopes of reference service. Research will be required to determine what factors are relevant to different types of digital libraries, in making these decisions. Digital libraries are only recently beginning to realize that they must integrate digital reference into the services they provide. Much work needs to be done to explore the intricacies of this integration – as well over a century of research and practice has explored the integration of desk reference into physical libraries.

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