Museum Professionals and the Relevance of LIS Expertise

Paul F. Marty
College of Information
Florida State University

marty@ci.fsu.edu

Abstract

This article presents results from a survey designed to assess the relevance of library and information science (LIS) expertise—here defined as those topics typically, but not exclusively, taught in LIS programs—for museum professionals. The topics covered in this article are information representation, information organization and access, information management, computer technologies, digitization technologies, interactive technologies, information policy, evaluation methods, and collaboration initiatives. An online survey assessed the degree to which museum professionals possess skills in these topics, perform work in these topics, and consider these topics important for future study. The article examines the relative value of each topic for museum professionals, and discusses the importance of strengthening relationships between LIS and museum studies by better understanding the relevance of LIS expertise in museums.

Keywords

Museum informatics; museum information professionals; library and information science education.

1. Introduction

Over the past decade, an increasing number of researchers have explored the sociotechnical interactions that take place between people, information, and technology in museums, an area of study referred to as museum informatics (Marty, Rayward, & Twidale, 2003). To meet the changing information needs and expectations of their visitors, museum professionals need to be capable of setting information policy, managing information resources, administering content management systems, implementing metadata standards, evaluating information interfaces, etc. From a conceptual perspective, these are not new problems: museum professionals have a great deal of experience with information management (Orna & Pettitt, 1998) and have been using computer technologies to track information since the 1960s (Ellin, 1969; Vance, 1975). From a practical perspective, however, today's museum professionals rely increasingly heavily on information management skills typically developed in schools of library and information science (LIS), a situation that has prompted a number of authors to call for studies of the overlap between LIS and museum studies programs (Giannini, 2006; Jörgensen, 2004; Marty, 2006a).

There has long been a close relationship between museum studies and LIS. Given their skills in information organization, most museum professionals can be considered information professionals in some sense (Lord & Lord, 1997), and many museum employees, particularly museum librarians and registrars, have LIS backgrounds (Case, 1995; Koot, 2001; Reed & Sledge, 1998). Museum professionals, along with librarians and archivists, have wrestled with information management issues for thousands of years as they worked to preserve and advance the state of human knowledge (Hedstrom & King, 2003; cf. MacDonald, 1991). More recently, the increased use of digital information resources has blurred traditional distinctions between information organizations, leading to a functional convergence of museums, libraries, and archives (Rayward, 1998).

Despite these close ties, museum professionals are increasingly concerned about their ability to find employees who understand information organization and management within the unique information environment of the museum (Marty, 2006b). The majority of museum professionals have not received formal training in these areas, despite the acknowledged value of these skills for museums (Marty, 2005). This can lead to a problem where those individuals with expertise in information organization and management do not necessarily have a proper understanding of what it means to work as an information professional in a museum. For museum and information professionals, overcoming this problem presents an opportunity for growth. Properly positioned, LIS programs can become a valuable source of expertise for museum professionals looking to meet the changing information needs of their visitors (Marty, 2007).

To encourage a stronger relationship between LIS and museum studies programs, this article explores how museum professionals employ skills that can be considered as falling under the purview of LIS programs, and argues for a better understanding of the relevance of those skills for museum professionals. Taking such an approach to exploring the relationship between museum studies and LIS does not mean that there are skills unique to libraries that are not present in museums, or that there are skills unique to museums that are not found in libraries. Rather, this article uses the term "LIS expertise" to refer to skills typically taught in LIS programs without implying that those skills are exclusively the province of LIS professionals.

When viewed from this perspective, a study of LIS expertise in museums does not diminish the abilities of museum professionals, but calls attention to their ability to develop and use a wide range of skills as needed. While many museum professionals possess skills that are taught in LIS programs, they have typically acquired these skills on the job; unless they specifically have backgrounds in LIS, museum professionals usually do not have formal training in information organization and management (Marty, 2005). The need for museum professionals to develop the ability to guide their museums through the hazards of planning digitization projects, purchasing collections information systems, or joining online data sharing consortia reflects the growing importance of change management and professionalism in museums (Cossons, 1985; Kavanagh, 1994; Suchy, 2004). Today's museum professionals must be able to adapt to changing situations, learning new skills and developing new solutions in response to internally and externally imposed problems (Janes, 1997). Familiarity with the skills typically taught in LIS programs is an essential component of meeting the constantly changing information needs and expectations of the users of museum resources.

As museum and information professionals develop closer relationships between museum studies and LIS programs, it is important to understand how the skills typically taught in LIS programs, what this article refers to as LIS expertise, relate to museum professionals. It is particularly important to reach those museum professionals who are interested in the future of information science and technology in museums, as it is these individuals who are most likely to lead their museums into the 21st century. This article reports on the relevance of LIS expertise for museum professionals as a necessary step in developing a better understanding of the overlapping skills of museum and information professionals, and strengthening the relationship between LIS and museum studies.

2. Problem Statement

While the skills typically taught in LIS programs are important for museum professionals, little is known about the specific LIS skills museum professionals possess and use on the job, despite extensive materials covering the application of those skills in museums. Research is lacking that explores the changing nature of LIS expertise in museums, and how museum professionals are adapting to these changes. As LIS researchers and professionals work to build closer relationships among information organizations such as museums, it is necessary to identify the areas of LIS expertise that museum professionals consider most important to the future of museum information work.

To address this need, this article explores three research questions:

1. In what LIS areas do museum professionals possess skills, competencies, or experience?

2. In what LIS areas do museum professionals perform work?

3. In what LIS areas are museum professionals interested in learning more or keeping current?

Answering questions about the relevance of LIS expertise in museums will help researchers interested in museum informatics direct their research activities, LIS students interested in museum careers direct their studies, museum professionals determine the LIS skills most important for them to learn, museum administrators direct their hiring activities, and the LIS community better understand the needs and expectations of museum professionals.

3. Literature Review

Many topics covered in LIS programs are potentially important to museum professionals, and it is beyond the scope of this article to address all areas of potential overlap between LIS and museum studies (for a broad overview, please see Marty, Rayward, & Twidale, 2003). This section highlights some of the more important areas of overlap, and identifies the challenges facing museum professionals as they integrate LIS expertise into museums.

Museum professionals in modern museums interact regularly with a wide variety of different information resources, including the museum's collections, information about collections, and information about the contexts in which collections are displayed, studied, and interpreted. To succeed at their jobs, museum professionals need to be comfortable with handling information representations of museum artifacts (Cameron, 2003; Rayward, 1998), developing organization schemas for storing and providing access to museum records (Coburn & Baca, 2004; Perkins, 2001), and using collections management systems (Blackaby, 1997; Hamma, 2004b; Lynch, 2002). The principles and practices of information resource management in museums are well documented (Orna & Pettitt, 1998). The various editions of *Museum Registration Methods* (Buck & Gilmore, 1998; Dudley & Wilkenson, 1979), for instance, provide guidance for museum registrars documenting their collections, while other resources document the tasks of museum registrars themselves (Case, 1995). Developing information representations of museum artifacts requires museum professionals to have expertise with metadata standards, classification schemes, and controlled vocabularies (Gill, Gilliland-Swetland, & Baca, 1998; Gilliland-Swetland & White, 2004; Lanzi, 1998). Museum professionals also need to be able to use collections management systems (Bearman, 1994; Wentz, 1995), and electronic information systems have been used for these purposes since the 1960s (Rush & Chenhall, 1979; Schoener, 1969; Vance, 1975).

Over the past few decades, many new technologies have been introduced into museums, with the result that museum professionals frequently rely on information technologies to complete even the basic tasks required keep the museum functioning (Zorich, 1997). To use these new technologies effectively, museum professionals need skills in using computer technologies on the job (Hermann, 1997), working with digitization technologies for creating and managing digital representations of museum resources (Zorich, 1999), and integrating interactive technologies into museum exhibits, in house and online (Economou, 1998). While researchers and professionals have written about the use of information technology in museums since the late 1960s (Ellin, 1969; Licklider, 1969), new technologies have the potential to revolutionize the experience of working in or visiting a museum (Besser, 1997b; Knell, 2003). Skills with digitization and digital imaging, for instance, have become increasingly important as museums offer visitors access to digital versions of their collections (Besser, 1997a; Johnston, 1997). At many museums, interactive technologies augment the museum-going experience, allowing visitors to explore

topics in greater detail and at their own pace (Bowen & Filippini-Fantoni, 2004; Hamma, 2004a; Jones-Garmil, 1997; Schwarzer, 2001; Thomas & Mintz, 1998). As such technologies become more common, researchers have assessed the opportunities interactive technologies afford museum visitors (Devine & Hanson, 2001; Evans & Sterry, 1999; Rayward & Twidale, 2000; Schaller & Allison-Bunnell, 2005; Teather & Wilhelm, 1999) as well as their value for increasing interactions between visitors and museum exhibits (Aoki et al., 2002; Boehner, Gay, & Larking, 2005; Wakkary & Evernden, 2005; Woodruff et al., 2002).

Museum professionals need the ability to interact with the users of museum resources and meet their constantly changing information needs. Museum visitors expect to find detailed information about museum artifacts online (including digital images), users from academia expect to be able to access information resources that meet scholarly needs, and other museum professionals expect collections data to be stored in a format that facilitates sharing among different institutions. To keep up with these expectations, museum professionals need the ability to establish information policies covering such things as digital rights management and intellectual property (Carson, 2001), to perform evaluations to determine the effectiveness of museum resources in meeting user needs (Ockuly, 2003), and to participate in museum collaborations designed to share collections data (Bennet & Sandore, 2001). Access to digital images of museum artifacts has prompted concerns about copyright issues and control over intellectual property (Gladney, Mintzer, & Schiattarella, 1997; Zorich, 2000), and explorations of new economic and technical models for providing access to digital cultural heritage (Bearman, 1997; Sherwood, 1997). Museum professionals need skills with user-centered evaluations to determine the information needs of museum visitors (Booth, 1998; Kravchyna & Hastings, 2002; Thomas & Carey, 2005), and how successful they are at meeting those needs (Cunliffe, Kritou, & Tudhope, 2002; Harms & Schweibenz, 2001; Hertzum, 1998; Peacock, 2002; Streten, 2000). As their tasks become more complex, museum professionals may collaborate to achieve their goals and objectives, and a number of studies have explored the challenges of building and maintaining museum consortia (Allen, 2000; Martin, Rieger, & Gay, 1999; Rinehart, 2001; Sayre & Wetterlund, 2003; Trant, Bearman, & Richmond, 2000).

4. Procedures

In the Fall of 2004, the researcher identified 22 courses at 17 different universities in the United States that specifically dealt with some aspect of information science and technology in museums by searching program descriptions and course syllabi available online. Sixteen of these courses were taught in museum studies programs, and covered such topics as digital imaging, interactive technologies in museum exhibits, and the history of information technology in museums. The remaining six courses were taught in schools of library and information science, and covered such topics as museum informatics, electronic records management, and collections management in museums. The researcher used the course syllabi to perform a content analysis to isolate and compare key concepts taught in these courses, identifying a total of 56 different concepts including digital preservation, digital rights management, the evaluation of interactive exhibits, metadata standards, and website design.

Grouping these concepts into different subject areas, the researcher developed a list of nine general topics of LIS expertise considered important for museum professionals to understand. As

discussed in the introduction, the term "LIS expertise" refers to topics typically covered in LIS programs and does not mean to imply that such topics are not taught outside of LIS programs. As demonstrated by the above course breakdown, there are a number of museum studies programs where such topics are already being covered, even if these programs focus almost exclusively on the use of information technologies in museums. From a conceptual perspective, LIS programs remain the primary educational institution responsible for teaching many of these topics, although they may be presented without a specific discussion of their potential use in museums. That most LIS programs do not specifically teach courses designed for museum professionals provides further evidence of the need to explore the relevance of LIS expertise in museums.

While some overlap in topics was unavoidable, the following list represents the researcher's best effort to identify concepts that overlapped as little as possible without being overly cumbersome for the research participants. The nine topics identified for this study were:

- *Information Representation* (IR), the creation of information surrogates or aggregates that can be manipulated more easily than physical objects; examples of this topic as applied in museums include registration methods, records management, creating digital or physical object surrogates, etc.

- *Information Organization and Access* (IO), the establishment of conceptual frameworks for organizing and retrieving information resources; examples of this topic as applied in museums include metadata schemas, classification systems, standardized terminologies, controlled vocabularies, standards for data sharing, etc.

- *Information Management* (IM), the development of systems and procedures supporting all stages of the information resource life-cycle within an information organization; examples of this topic as applied in museums include content management systems, collections management systems, integrated information systems, etc.

- *Computer Technologies* (CT), the use of electronic systems to store, retrieve, and manipulate digital information resources; examples of this topic as applied in museums include networking, programming, database systems, web applications, multimedia development, etc.

- *Digitization Technologies* (DT), the development of electronic representations of physical objects and information resources; examples of this topic as applied in museums include digital objects, digital imaging, digital preservation, conversion of paper-based to electronic records, etc.

- *Interactive Technologies* (IT), the creation of information systems designed to mediate between digital resources and the users of those resources; examples of this topic as applied in museums include audio guides, handheld computers, pervasive computing, multimedia technologies, online exhibits, online collections, virtual museums, etc.

- *Information Policy* (IP), the development of objectives and procedures that govern the creation and use of information in an organization; examples of this topic as applied in museums include intellectual property, copyright, digital rights management, etc.

- *Evaluation Methods* (EM), the process of assessing the ability of information systems or resources to meet the information needs of users; examples of this topic as applied in museums include visitor studies, needs assessment, usability analysis, etc.

- *Collaboration Initiatives* (CI), the management of relationships between different information organizations working to achieve common goals; examples of this topic as applied in museums include inter-museum consortia, educational and community outreach programs, information resource sharing projects, etc.

The researcher then designed a survey questionnaire to assess the degree to which museum professionals possess skills in these topics, perform work in these topics, and consider these topics important for future museum professionals to study. To ensure that each participant shared a basic understanding of the nine topics, the above examples of how each topic applied to museums were included in the survey. The survey featured six primary questions, grouped into three sets of two questions, about the nine topics listed above. Participants were also provided the opportunity to enter free text comments about the topics covered in the survey, allowed to enter an email address if they wished to participate in follow-up interviews, and asked a few demographics questions (covering where they work, what they do, and for how long).

The six primary survey questions were:

- Of the nine topics, in which do you have skills, competencies, or experience? (Q1a)

- Of the topics selected in Q1a, in which have you received formal training or instruction? (Q1b)

- Of the nine topics, in which have you worked over the past five years? (Q2a)

- Of the topics selected in Q2a , which do you think have increased in importance over the past five years? (Q2b)

- Of the nine topics, which are you interested in keeping current or learning more over the next five years? (Q3a)

- Of the topics selected in Q3a, which are you interested in pursuing through online courses? (Q3b)

The survey was made available online, and invitations to participate in this project were sent to five LIS and museum-related listservs: MUSEUM-L, H-MUSEUM, JESSE, MCN-L, and ARCHIVES-L. These listservs were chosen as the ones most likely to reach a broad range of individuals interested in the relevance of LIS expertise in museums. The intention in selecting these listservs was not to reach a representative number of museum professionals worldwide, but

to gain insights into the mindset of those individuals interested in the relationship between LIS and museum studies. A principal difficulty with doing this type of research is that no integrated list of suitable survey participants is available for researcher use; it is impossible to obtain a complete list of all museum professionals worldwide, let alone a list of individuals interested in specific survey topics such as LIS expertise in museums.

The invitation to participate in the survey specifically asked for individuals "interested in the future of information science and technology in museums" to "identify topics that pertain to the application and use of information science and technology in museums (an area of research called museum informatics), and that are of interest to museum professionals." Survey participants were also told that the results of the survey would be used to "inform the development of a new program of study in museum informatics." The exact wording of the initiation is important for understanding the mindset of the survey respondents, who were necessarily self-selected from the above listserv communities as having interests commensurate with the needs of the study's research questions (see below for more information about the survey respondents).

This article provides results and summary statistics for the museum professionals who responded to this survey. It was not possible to compare responses by demographics, as the wide variation in respondent demographics, as well as the open-ended nature of the responses, limited the researcher's ability to compare individuals by number of years in the museum profession, by type of museum career, or by the type of museum in which respondents worked. As discussed below, the data gathered do not allow for meaningful comparisons between groups; trying to create meaningful subdivisions out of the respondent demographics would be counter-productive and would detract from the need to look at the survey responses holistically.

To determine the strength of relationships between the nine topics according to the survey participants, Pearson's correlation coefficients were calculated for the respondents' answers to the questions about the topics in which they have skills, competencies, or experience (Q1a), the topics in which they have worked (Q2a), and the topics in which they are interested in keeping current or learning more (Q3a). In addition, the researcher asked several questions during the analysis to assess, for instance, the likelihood that respondents have been formally trained in those topics for which they have expertise, are interested in pursuing further studies in those topics in which they work, or believe that the topics in which they work have increased in importance over the past five years:

- Of participants with skills, competencies, or experience in any given topic, what percentage acquired those through formal training or instruction? (R1)

- Of participants who perform work in any given topic, what percentage believe that topic has increased in importance over the past five years? (R2)

- Of participants interested in keeping current or learning more about any given topic, what percentage wish to do so through online courses? (R3)

- Of participants with skills, competencies, or experience in a given topic, what percentage perform work in that topic? (R12)

- Of participants who perform work in any given topic, what percentage have skills, competencies, or experience in that topic? (R21)

- Of participants with skills, competencies, or experience in a given topic, what percentage wish to keep current or learn more about that topic? (R13)

- Of participants who wish to keep current or learn more about any given topic, what percentage have skills, competencies, or experience in that topic? (R31)

- Of participants who perform work in any given topic, what percentage wish to keep current or learn more about that topic? (R23)

- Of participants who wish to keep current or learn more about any given topic, what percentage perform work in that topic? (R32)

These questions were important for exploring the relationship, for example, between the work museum professionals perform and the expertise they possess, or between their areas of expertise and the topics about which they would like to learn more. The answers to these questions were calculated by examining each respondent's record individually, not by comparing summary responses to the six survey questions. For example, the answer to question R1 could not be calculated by simply dividing the Q1b summary value with the Q1a summary value, as a small number of respondents identified topics for Q1b that they had not marked for Q1a.

The following section reports on the results of this analysis. Note that this survey is part of a broader research agenda exploring the role of information professionals in museums, and builds on prior work by the author in this area (Marty, 2005; 2006a; 2006b; 2007). Some aspects of this study (such as interviews with selected survey participants) will be published in future articles. In addition, this survey lays the groundwork for a future large-scale census of the relevance of LIS expertise and information professionals working in museums.

5. Results

There were 132 valid responses by museum professionals to the invitation to participate in this survey. While the problems of using mailing lists with overlapping memberships makes it impossible to specify response rates, 132 responses is clearly not enough to argue that these answers are representative of museum professionals in general or even the total population on the mailing lists used in this research. The point of this research, however, was not to get a representative sample of all museum professionals worldwide, but to reach the small number of museum professionals interested in issues of information science and technology in museums. Therefore, while the results of this study are not generalizable to all museum professionals, the results do provide valuable insights into the mindset of those museum professionals who are currently thinking about the role of LIS expertise in museums.

As discussed above, the invitation to participate specifically asked museum professionals interested in the future of information science and technology in museums to complete the survey. The 132 survey responses illustrate the opinions of museum professionals interested in this issue and who chose to answer the survey. As discussed elsewhere in detail (Marty, 2006a; Marty, 2007), it is this small number of cutting-edge individuals who are most likely to be leading their museums into the 21st century, and understanding their mindset is crucial for understanding the future of information science and technology in museums. In the remainder of this article, therefore, the term "museum professionals" refers to the subset of museum professionals subscribed to the above listservs who elected to respond to this survey, thereby identifying themselves as interested in the relationship between LIS and museum studies.

These 132 museum professionals had anywhere from less than one to more than 35 years of experience in the field. They worked in almost every possible type of museum, including art museums, natural history museums, anthropology museums, historical societies, science and technology museums, arboretums, aquariums, cultural centers, and many more. They identified themselves as exhibit designers, librarians, curators, archivists, catalogers, conservators, consultants, database developers, educators, directors, webmasters, registrars, and so on. This wide variety of respondent demographics illustrates how an interest in the future of information science and technology in museums is not limited to any one type of museum professional. Individuals interested in the relevance of LIS expertise in museums reflect a wide range of museum positions, backgrounds, and expertise, and an examination of these respondents as a group can help illustrate the changing relationship between LIS and museum studies.

Table 1 presents the summary results (expressed as percentages) for the 132 museum professionals for the six primary survey questions and nine analysis questions; column headings referring to this table have been inserted into the text in parenthesis where appropriate to provide guidance for the reader.

[INSERT TABLE 1 HERE]

5.1 Topics in which the respondents possess expertise

Columns Q1a and Q1b in Table 1 show the percentage of survey participants who possess expertise in each of the nine LIS topics, and the percentage of survey participants who received formal training or instruction in those topics; column R1 shows the percentage of museum professionals with expertise in a given area who acquired that expertise through formal training or instruction. According to the survey results, the most common skills, competencies, or experiences of museum professionals (Q1a) were Information Management and Information Organization and Access, with more than 75% of participants claiming expertise with these topics, followed closely by Information Representation and Computer Technologies, with more than 70% claiming expertise with those topics; the least common topics were Evaluation Methods and Interactive Technologies, with less than 50% of participants claiming expertise with these topics. Formal training or instruction did not play a major role for the vast majority of the museum professionals surveyed for any of the nine given topics (Q1b); survey respondents were most likely to have received instruction in topics such as Computer Technologies or Information Organization and Access, and extremely unlikely to have been instructed in topics

such as Digitization Technologies or Collaboration Initiatives. In general, the likelihood that any given museum professional had been formally trained or instructed in a topic for which they possess expertise was less than 50% (R1).

Table 2 shows the Pearson correlations for the participants' responses to the question about those topics in which they have skills, competencies, or experience (Q1a). The participants' levels of expertise with LIS topics were not very strongly correlated overall; many of the responses correlated with $r < 0.2$. The strongest correlations were found among the three topics Information Representation, Information Organization and Access, and Information Management. In particular, possessing skills in Information Representation was a fairly good indicator of possessing skills in Information Organization and Access ($r = 0.44$), while possessing skills in Information Organization and Access was likewise a fairly good indicator of possessing skills in Information Management ($r = 0.44$). Possessing skills in Digitization Technologies was moderately positively correlated with possessing skills in Information Representation ($r = 0.27$), Information Organization and Access ($r = 0.29$), and Information Management ($r = 0.37$), and possessing skills in Evaluation Methods was moderately positively correlated with possessing skills in Interactive Technologies ($r = 0.31$).

[INSERT TABLE 2 HERE]

5.2 Topics in which the respondents perform work

Columns Q2a and Q2b in Table 1 show the percentage of survey participants who perform work in each of the nine LIS topics over the past five years, and the percentage of survey participants who think those topics have increased in importance over the past five years; column R2 shows the percentage of museum professionals who work in a topic that believe that topic has increased in importance. The most common topics in which museum professionals worked over the past five years were Information Organization and Access and Information Management, while the least common were Evaluation Methods and Interactive Technologies (Q2a). The majority of museum professionals believed that Digitization Technologies, Information Management, and Information Organization and Access increased in importance over the past five years (with Collaboration Initiatives and Computer Technologies close behind); only a small percentage believed Evaluation Methods and Information Representation increased in importance (Q2b). Participants who work in the topics of Digitization Technologies, Collaboration Initiatives, and Interactive Technologies were most likely to state that those topics increased in importance, while respondents who work in the topics of Information Representation (and to some extent Evaluation Methods) were much less likely to state that those topics increased in importance over the past five years (R2).

Table 3 shows the Pearson correlations for the participants' responses to the question about those topics in which they have worked over the past five years (Q2a). As with the Q1a correlations above, the topics in which the survey participants worked were not very strongly correlated overall. The strongest correlations were again found among the three topics Information Representation, Information Organization and Access, and Information Management. Performing work in Information Organization and Access was fairly positively correlated with performing work in Information Management ($r = 0.55$), as was performing work in Information

Representation with performing work in Information Organization and Access (r = 0.47) and Information Management (r = 0.39). Individuals who worked with Digitization Technologies demonstrated relatively strong correlations with Information Representation (r = 0.35), Information Organization and Access (r = 0.49), and Information Management (r = 0.41). Performing work with Computer Technologies was positively correlated with performing work in Information Representation (r = 0.25), Information Organization and Access (r = 0.30), Information Management (r = 0.22) and Digitization Technologies (r = 0.29), and the correlation between museum professionals who perform work in Evaluation Methods and those who work with Interactive Technologies remained relatively high (r = 0.41).

Columns R12 and R21 in Table 1 show the percentage of survey participants who perform work in the topics in which they possess expertise, and the percentage of survey participants who possess expertise with the topics in which they work. As can be seen from the data, the relationship between the topics at which museum professionals work and the topics with which they have experience is very strong. At least eighty percent of the surveyed museum professionals have experience with the topics in which they work (R21), and also work in topics with which they have experience (R12). The ability to work in a particular area, therefore, is a strong indication that museum professionals actually work in that area, and vice versa.

[INSERT TABLE 3 HERE]

5.3 Topics in which the respondents want to keep current

Columns Q3a and Q3b in Table 1 show the percentage of survey participants who are interested in keeping current or learning more about each of the nine LIS topics over the next five years, and the percentage of survey participants who are interested in pursuing these interests through online courses; column R3 shows the percentage of those museum professionals interested in keeping current or learning more about any given topic who would like to do so through online courses. The topics about which museum professionals would most like to keep current or learn more over the next five years (Q3a) were Digitization Technologies and Interactive Technologies, with Information Management, Computer Technologies, and Collaboration Initiatives tied for third place; as a group, museum professionals were relatively uninterested in learning more about Information Representation or Evaluation Methods. Museum professionals were most interested in studying Digitization Technologies and Interactive Technologies online, and less interested in studying Information Representation, Information Policy, or Collaboration Initiatives online (Q3b). Nevertheless, the majority of participating museum professionals generally favored online education (R3).

Table 4 shows the Pearson correlations for the participants' responses to the question about those topics in which they are interested in keeping current or learning more over the next five years (Q3a). As with the Q1a and Q2a correlations above, the topics for which the survey participants wanted to keep current or learn more were not very strongly correlated overall. The strongest positive correlations were again found among the three topics Information Representation, Information Organization and Access, and Information Management. Keeping current or learning more about Information Representation correlated fairly strongly with Information Organization and Access (r = 0.44) and with Information Management (r = 0.36), while keeping

current or learning more about Information Organization and Access correlated strongly with Information Management (r = 0.52). Interests in keeping current or learning more about Computer Technologies correlated relatively strongly with Information Representation (r = 0.20), Information Organization and Access (r = 0.21), Information Management (r = 0.27), Digitization Technologies (r = 0.26), and Interactive Technologies (r = 0.25), while keeping current or learning more about Digitization Technologies also correlated relatively strongly with Information Representation (r = 0.26), Information Management (r = 0.30), Computer Technologies (r = 0.25), and Interactive Technologies (r = 0.21). Finally, keeping current or learning more about Evaluation Methods correlated relatively strongly with Interactive Technologies (r = 0.20), Information Policy (r = 0.20), and Collaboration Initiatives (r = 0.23).

Columns R13 and R31 in Table 1 show the percentage of survey participants who are interested in learning more or keeping current with the topics in which they possess expertise, and the percentage of survey participants who possess expertise with the topics in which they wish to learn more or keep current. The relationship between having skills in a particular area and wanting to keep current or learn more about that area is relatively strong for museum professionals. With the exception of Information Representation (47%), the majority of museum professionals were interested in learning more about those topics with which they already had expertise (R13), especially in the topics of Digitization Technologies (79%), Collaboration Initiatives (74%), and Interactive Technologies (70%). With the exceptions of Interactive Technologies (46%) and Evaluation Methods (44%), the majority of museum professionals were already likely to possess skills in those topics about which they would like to learn more (R31), especially Information Organization and Access (90%), Information Representation (87%), and Information Management (87%).

Columns R23 and R32 in Table 1 show the percentage of survey participants who are interested in learning more or keeping current with the topics in which they work, and the percentage of survey participants who work in the topics in which they wish to learn more or keep current. The relationship between working in a particular area and wanting to keep current or learn more about that area is relatively strong for museum professionals. With the exception of Information Representation (49%), the majority of museum professionals wanted to learn more about the topics in which they work (R23), especially Digitization Technologies (80%) and Collaboration Initiatives (72%). With the exceptions of Interactive Technologies (41%) and Evaluation Methods (46%), the majority of museum professionals were already working in topics in which they also wanted to learn more (R32), especially Information Organization and Access (87%), Information Representation (85%), and Information Management (83%).

[INSERT TABLE 4 HERE]

6. Discussion

These results provide valuable insights into the mindset of museum professionals interested in the future of information science and technology in museums, and provide some indication of future trends of LIS expertise in museums. The findings illustrate a shift in interest away from more common skills many museum professionals already possess to new, more cutting-edge topics which they feel will keep them moving forward and better prepare them for future

challenges. Interest in more traditional LIS topics such as information representation, information organization and access, and information management is waning, along with interest in basic computer technologies skills, while interest in topics such as digitization technologies, information policy, and collaboration initiatives continues to grow (albeit slowly), and topics such as interactive technologies and evaluation methodologies are poised to explode in potential value for museum professionals in the future.

To guide this discussion, Figure 1 presents graphically the summary results from the three questions covering the topics in which the survey respondents have skills, competencies, or experience (Q1a), the topics in which they have worked (Q2a), and the topics in which they are interested in keeping current or learning more (Q3a). While lines are provided to make the figure easier to follow, the lines imply neither connections nor causality among the responses. This figure portrays the survey responses for the museum professionals as a group, and therefore the percent changes depicted on this graph should not necessarily be interpreted as applying to each respondent individually. Despite these caveats, this graphical depiction of the main study findings can help illustrate many of the points presented above. For instance, for all nine topics, the link between Q1a and Q2a is essentially a straight line (increasing or decreasing by no more than five percentage points) confirming the finding that there is a strong relationship between the topics at which museum professionals work and the topics with which they have experience (R12 and R21). On the other hand, the links between Q2a and Q3a tend to change dramatically (increasing or decreasing by up to 30 percentage points), confirming that the relationship between what museum professionals know and what they need (R13 and R31), and between what they do and what they need (R23 and R32), varies considerably from topic to topic. Some topics (such as Information Representation, Information Organization and Access, or Information Management) decrease from Q2a to Q3a, while other topics (such as Digitization Technologies, Interactive Technologies, or Evaluation Methods) increase.

[INSERT FIGURE 1 HERE]

6.1 Information Representation

The future of Information Representation in museums appears dim, as the majority of museum professionals consider Information Representation both uninteresting and unimportant. Despite the fact that 74% of museum professionals possess skills in Information Representation (Q1a) and 70% perform work in Information Representation (Q2a), only 40% are interested in keeping current or learning more about Information Representation (Q3a), and only 29% believe Information Representation to be a topic that has increased in importance over the past five years (Q2b). Given that less than half of those who possess skills in Information Representation (R13) or perform work in Information Representation (R23) want to keep current or learn more about Information Representation, one might assume that current museum professionals feel they know enough about Information Representation and have no desire to learn more. Those individuals least interested in learning more, however, are those who do not already possess expertise (R31) or work (R32) in Information Representation: four out of five museum professionals who know nothing about Information Representation are uninterested in learning about Information Representation in the future. This situation is distressing given the importance of Information Representation to museum activities. The relatively strong positive correlation between

possessing expertise or performing work in Information Representation and Digitization Technologies, for example, speaks to the need for museum professionals to be able to represent information in a variety of formats during the digitization process, an area which continues to be of critical importance for museum professionals. If the lack of interest in learning more about Information Representation is a foreshadowing of decreasing skills in Information Representation, museums may face serious challenges in information work that future employees will be ill-prepared to overcome.

6.2 Information Organization and Access

The attitude of museum professionals toward Information Organization and Access, while not overwhelmingly positive, appears to reflect the growing importance of providing access to museum information resources. As with Information Representation, most museum professionals possess expertise (77%) and perform work (76%) in Information Organization and Access, yet only 54% are interested in learning more or keeping current about this area. The vast majority of those individuals who want to learn more or keep current about Information Organization and Access already possess expertise (R31 = 90%) or perform work (R32 = 87%) in it; in addition, nearly half of those with knowledge of Information Organization and Access gained that knowledge through formal training or instruction (R1 = 49%). Given the importance of Information Organization and Access in the museum (like Information representation, Information Organization and Access is relatively strongly positively correlated with digitization technologies), this relative decline in interest in Information Organization and Access is potentially distressing. Nevertheless, despite that fact that only 10% of those individuals who want to learn about Information Organization and Access have no prior experience with Information Organization and Access, slightly more than half (51%) of the survey respondents considered Information Organization and Access to have increased in importance over the past five years (Q2b). It is possible that Information Organization and Access, with its emphasis on providing access to organized, and theoretically useful, information, is viewed by museum professionals as relating directly to the success of the museum in the eyes of an increasingly information-savvy public. That a slim majority of survey respondents consider Information Organization and Access to be increasing in importance is perhaps a sign that museum professionals recognize that an emphasis on Information Organization and Access will help them make their collections available to users desiring access to their information resources.

6.3 Information Management

Museum professionals are more likely to possess expertise with or perform work in the Information Management area than any other topic: 78% of museum professionals possess expertise (Q1a) and 76% perform work in Information Management (Q2a). While only 59% of museum professionals are interested in learning more or keeping current in Information Management (a decrease of 22% from Q2a to Q3a), this still represents the third highest score for this survey question, indicating the important role Information Management plays for museum professionals. 57% of the survey respondents believe that Information Management has increased in importance over the past five years, further underscoring the positive contributions museum professionals with experience in Information Management can offer museums in the information society. As with Information Organization and Access and Information

Representation, experience with Information Management is relatively strongly positively correlated with experience with Digitization Technologies, and as museum professionals convert more of their resources to digital formats, skills with content management systems will become increasingly valuable. Given the value of Information Management in museums, it is important that future museum professionals be encouraged to study Information Management, especially those with no prior experience in this area; more than 80% of those individuals who want to keep current or learn more about Information Management already possess expertise (R31) or perform work (R32) with Information Management. In this respect, Information Management is similar to Information Representation and Information Organization and Access in that it appears to be something that interests only those who already know something about it, despite the overall importance for Information Management in museums and a growing appreciation for Information Management among museum professionals in general.

6.4 Computer Technologies

Museum professionals appear to take skills in Computer Technologies for granted, and seem less interested in learning about Computer Technologies for the simple sake of learning about technology. Computer Technologies is unique; it is the only one of the nine topics that shows a slight, but constant, downward slope from Q1a (71%), to Q2a (66%), to Q3a (59%). This decrease in interest over time causes the Computer Technologies profile to resemble the profiles for Information Representation, Information Organization and Access, and Information Management more closely than it resembles the profiles for the other two technology skill areas, Digitization Technologies and Interactive Technologies. Computer Technologies appears to be something that museum professionals considered important in the past (nearly half of those with expertise in Computer Technologies received some formal training or instruction in Computer Technologies (R1)), but view as less important for the future: only 62% of people with experience in Computer Technologies think that it has increased in importance over the past five years (R2), compared to 80% for Digitization Technologies and 73% for Interactive Technologies. While skills in computer technologies remain valuable for museum professionals, these findings likely indicate that simply having skills in such computer technologies as database design or website development is no longer considered as important as learning how technologies can be used to achieve some particular goal or objective. As skills with Computer Technologies become more widespread in museums, and the difficulty of building a database or creating a website decreases, museum professionals are as a group less interested in learning more or keeping current with Computer Technologies, and more interested in learning how those skills can be applied in new areas.

6.5 Digitization Technologies

Skills in Digitization Technologies are clearly sought after by museum professionals, but it is possible that digitization is reaching a satiation point in museums. Almost the inverse of Computer Technologies, Digitization Technologies is unique in that it shows a slight upward trend from Q1a (64%), to Q2a (66%), to Q3a (72%). The increase from Q1a to Q2a is slightly odd, as it indicates that more museum professionals claim to be performing work with Digitization Technologies than claim to possess skills with Digitization Technologies. Given the importance of digitization work in museums, and that only 21% of museum professionals with

skills in Digitization Technologies learned those skills through formal training or instruction (R1), it is likely that some museum professionals are performing work in Digitization Technologies while learning about Digitization Technologies, even if they themselves feel they lack the required skills to do so. The pressure to work in Digitization Technologies reflects the overall importance of Digitization Technologies in museums: not only did 72% of the survey respondents desire to learn more or keep current in this area (Q3a), but 61% believed that Digitization Technologies has increased in importance over the past five years (Q2b), the highest percentages of all nine topics for both questions. Given the importance of Digitization Technologies in museums, it will likely not be long before nearly everyone working in a museum knows something about Digitization Technologies. When this occurs, the museum community may well see a leveling out with respect to Digitization Technologies skills, similar to what may be occurring with Computer Technologies. If everyone works in Digitization Technologies, then Digitization Technologies will become more commonly regarded as a basic skill everyone needs to some degree. It is likely that the emphasis on technologies in museums will continue to shift away from such tasks as the digitization of museum artifacts to ways in which information technologies can be used to provide new ways for museum visitors to interact with digital museum resources.

6.6 Interactive Technologies

Skills in designing and developing Interactive Technologies in museums are poised to increase dramatically in importance for museum professionals. While few museum professionals know about Interactive Technologies (Q1a = 41%), and even fewer perform work in Interactive Technologies (Q2a = 37%), the majority (Q3a = 62%) want to learn more or keep current with Interactive Technologies skills. This sizable increase from Q2a to Q3a (a relative increase of 68%) is the largest increase for all nine LIS topics, and indicates the importance of Interactive Technologies in museums; after Digitization Technologies, Interactive Technologies is the second most popular topic about which museum professionals want to learn more. The growing popularity of Interactive Technologies likely reflects the fact that an increasing number of museums now incorporate some form of interactive technologies into their exhibits. Museum visitors, as well as many museum professionals, expect museums to provide some kind of interactivity during their visits. The desire to meet this expectation is likely the driving factor behind the number of museum professionals who wish to learn about Interactive Technologies, despite the fact that more than half of them have no prior experience with Interactive Technologies (R31 and R32); along with Evaluation Methods (see below), this is unique among the nine topics. The Interactive Technologies topic is clearly an up and coming area of interest for museum professionals, one that attracts a broad range of museum professionals, not just those already involved with Interactive Technologies. These findings provide further evidence that the availability of technologies that allow visitors to interact with museum exhibits, in the galleries or online, is of critical importance to museum visitors and museum professionals.

6.7 Information Policy

Museum professionals are aware that Information Policy is important for museums, but they seem slightly uncertain about how skills in Information Policy will manifest themselves in the future. While approximately half of the survey respondents know about Information Policy (Q1a

= 54%), work in Information Policy (Q2a = 49%), and want to learn more about Information Policy (Q3a = 55%), the survey responses illustrate neither the underlying excitement seen with Interactive Technologies nor the all-encompassing importance of Digitization Technologies. Overall, interest in Information Policy seems to be neither increasing nor decreasing, and the roughly similar responses for R13 and R31 (as well as R23 and R32) indicate that interest in learning more about Information Policy is neither limited to those who already know about Information Policy (as with Information Representation) nor attractive to those who know nothing about Information Policy (as with Interactive Technologies). The responses to questions about Information Policy strike a balance among survey respondents, as if museum professionals are slightly uncertain about Information Policy, even though Information Policy is clearly something museum professionals need to know. This situation likely reflects how museum professionals are grappling with Information Policy issues, especially as they ask whether museums should retain control over digital images of works of art. Given the positive correlation between performing work with Information Policy and Digitization Technologies (r = 0.26), it is possible that skills in Information Policy will increase in importance as more museum professionals digitize their collections and wrestle with the questions that arise when digital resources are made available online.

6.8 Evaluation Methods

Museum professionals with skills in Evaluation Methods are relatively uncommon in museums, yet the growing interest in the application of Evaluation Methods in museums is second only to the growing interest in the use of Interactive Technologies in museums. While only 34% (Q1a) of museum professionals possess expertise in Evaluation Methods, and only 33% (Q2a) perform work in Evaluation Methods, 43% (Q3a) wish to learn more or keep current about Evaluation Methods (a relative increase from Q2a to Q3a of 30%). Even though this represents less than half of the survey respondents, it appears that Evaluation Methods may be poised to become important for a broad range of museum professionals. As with Interactive Technologies, museum professionals who wish to learn about Evaluation Methods are not limited to those who already know about Evaluation Methods: more than half of those who wish to learn more about Evaluation Methods have no prior experience with Evaluation Methods (R31). Skills with Evaluation Methods seem not to be learned on the job: despite the fact that few museum professionals possess expertise with Evaluation Methods, nearly half of those that do have been formally trained in Evaluation Methods (R1 = 47%). The solid positive relationship (r = 0.41) between the ability to perform work with Evaluation Methods and Interactive Technologies likely indicates that as museum professionals focus on developing new, interactive technologies that meet the growing expectations of museum visitors, the ability to evaluate whether those technologies meet user needs is becoming increasingly important.

6.9 Collaboration Initiatives

The majority of museum professionals have a growing interest in Collaboration Initiatives skills, and there is a sense among survey respondents that Collaboration Initiatives will continue to increase in importance for museums. Slightly more than half of survey respondents know about Collaboration Initiatives (Q1a = 56%), work in Collaboration Initiatives (Q2a = 55%), and want to learn more about Collaboration Initiatives (Q3a = 59%). While these figures do not represent a

dramatic increase in interest, a very high percentage of museum professionals who work in Collaboration Initiatives believe that Collaboration Initiatives has increased in importance over the past five years (R2 = 76%, second only to Digitization Technologies), and the 59% of all museum professionals who want to learn more or keep current about Collaboration Initiatives represents the third highest score for Q3a. Skills in Collaboration Initiatives appear to be learned on the job: very few (Q1b = 13%) museum professionals received formal training or instruction in Collaboration Initiatives (the smallest number for all nine topics). That so many museum professionals perform work in Collaboration Initiatives, despite so few having been formally trained in Collaboration Initiatives, likely indicates the growing importance of knowing how to participate in collaboration initiatives. Collaboration skills are critically important if museum professionals are to develop, manage, and maintain collaborative relationships among consortia of museums in the information society. Future museum professionals will need skills with Collaboration Initiatives if their museums are to succeed in a networked world where the ability to collaborate on data sharing projects is as important as the ability to create digital surrogates of museum artifacts or develop interactive technologies for museum visitors.

7. Conclusion

For museum professionals interested in the future of information science and technology in museums, the future of LIS expertise in museums lies at the intersection where information resources and information technologies overlap with the use of these resources and technologies by people in museums. For many, simply working with computer technologies or information resources (e.g. cataloguing museum collections, managing information representations of museum artifacts, etc.) is no longer enough to evoke excitement, nor are they interested in actively pursuing those skills. As museum professionals work to digitize their collections and integrate information technologies into all aspects of museum operations, they concentrate their efforts on using information technologies to reach museum visitors through new forms of interactivity, and on developing the skills they need to assess the degree to which those interactions have a positive impact on museum visitors. Today's museum professionals are interested in learning more about how information and technology can work together to improve the museum experience for all users of museum resources; skills in information science or information technology alone are not as important as the ability to combine those skills in order to help connect people, information, and technology in museums.

This study has implications for LIS researchers interested in the future of information work in museums. First, it should encourage researchers and professionals to develop collaborative endeavors that strengthen current relationships between libraries, archives, and museums. Second, it should encourage LIS researchers to find new ways of cooperating with museum professionals as they study information needs, develop interactive technologies, and evaluate their ability to meet those needs. Finally, it should encourage current museum professionals as well as students planning museum careers to take courses from both museum studies and LIS programs as a way of building bridges between those disciplines, improving understanding of the commonalities shared by LIS and museum professionals, and producing more graduates with the diverse skills and expertise to drive the ongoing convergence of libraries, archives, and museums. In this way, this study will help museum and information professionals encourage

greater collaboration between museums, libraries, archives, and better integration between LIS and museum studies programs.

As museum professionals look forward to new ways of interacting with information resources, technologies, and users, there is an unprecedented opportunity to promote integration and cross-disciplinary collaborations between museum studies and LIS. It is critically important that everyone interested in the convergence of libraries, museums, and archives understand the directions in which museums are headed, and the changing needs and expectations of the museum professionals who work in those museums. Museum professionals interested in the future of information science and technology in museums are aware of the critical importance of LIS expertise, and the future of museums in the information society will be shaped by those individuals interested in crossing boundaries between LIS, museum studies, and domain-specific areas such as art history or anthropology. Only by encouraging these future museum employees to focus on how users of all types, including museum professionals and museum visitors, interact with information resources and technologies in museums, will they be positioned to help museums successfully navigate between the rich historical traditions of LIS and the potentials of new information technologies for museums.

Acknowledgements

The author would like to acknowledge the efforts of his research assistants, Anna Wilcoxon and Nancy Enterline, master's students in the College of Information, as well as the contributions of the anonymous reviewers who helped improve this manuscript.

References

Allen, N. (2000). Collaboration through the Colorado digitization project. *First Monday, 5*(6). Retrieved October 1, 2006, from http://www.firstmonday.org/issues/issue5_6/allen

Aoki, P.M., Grinter, R.E., Hurst, A., Szymanski, M.H., Thornton, J.D., & Woodruff, A. (2002). Sotto voce: Exploring the interplay of conversation and mobile audio spaces. In *Proceedings of the SIGCHI conference on human factors in computing systems: Changing our world, changing ourselves* (pp. 431-438). New York: ACM Press.

Bearman, D. (1994). Strategies for cultural heritage information standards in a networked world. *Archives and Museum Informatics, 8*, 93-106.

Bearman, D. (1997). New economic models for administering cultural intellectual property. In K. Jones-Garmil (Ed.), *The wired museum: Emerging technology and changing paradigms* (pp. 231-266). Washington, D.C.: American Association of Museums.

Bennet, N., & Sandore, B. (2001). The IMLS digital cultural heritage community project: A case study of tools for effective project management and collaboration. *First Monday, 6*(7). Retrieved October 1, 2006, from http://firstmonday.org/issues/issue6_7/bennett

Besser, H. (1997a). The changing role of photographic collections with the advent of digitization. In K. Jones-Garmil (Ed.), *The wired museum: Emerging technology and changing paradigms* (pp. 115-128). Washington, D.C.: American Association of Museums.

Besser, H. (1997b). The transformation of the museum and the way its perceived. In K. Jones-Garmil (Ed.), *The wired museum: Emerging technology and changing paradigms* (pp. 153-170). Washington, D.C.: American Association of Museums.

Blackaby, J. (1997). Integrated information systems. In K. Jones-Garmil (Ed.), *The wired museum: Emerging technology and changing paradigms* (pp. 203-230). Washington, DC: American Association of Museums.

Boehner, K., Gay, G., & Larking, C. (2005). Drawing evaluation into design for mobile computing: A case study of the Renwick Gallery's handheld education project. *International Journal on Digital Libraries, 5*(3), 219-230.

Booth, B. (1998). Understanding the information needs of visitors to museums. *Museum Management and Curatorship, 17*, 139-157.

Bowen, J., & Filippini-Fantoni, S. (2004). Personalization and the Web from a museum perspective. In D. Bearman & J. Trant (Eds.), *Museums and the Web 2004* (pp. 63-78). Toronto, CA: Archives and Museum Informatics.

Buck, R. & Gilmore, J. (Eds.). (1998). *The new museum registration methods*. Washington, DC: American Association of Museums.

Cameron, F. (2003). Digital Futures I: Museum collections, digital technologies, and the cultural construction of knowledge. *Curator, 46*, 325-340.

Carson, C. (2001). Copyright and the Dead Sea Scrolls: A case study of the intellectual property issues involved in the research use of collections. *Spectra, 28*(3), 18-30.

Case, M. (Ed.). (1995). *Registrars on record: Essays on museum collections management*. Washington, DC: American Association of Museums.

Coburn, E., & Baca, M. (2004, June). Beyond the gallery walls: Tools and methods for leading end-users to collections information. *Bulletin of the American Society for Information Science and Technology, 30*(5), 14-19.

Cossons, N. (Ed.). (1985). *The management of change in museums*. London: The National Maritime Museum.

Cunliffe, D., Kritou, E., & Tudhope, D. (2001). Usability evaluation for museum Web sites. *Museum Management and Curatorship, 19*, 229-252

Devine, J., & Hansen, C. (2001). Light from shade: Educational access to museum collections through digital technologies. *Spectra*, *28*(2), 38-40.

Dudley, D., & Wilkenson, I. (Eds.). (1979). *Museum registration methods*. Washington, DC: American Association of Museums.

Economou, M. (1998). The evaluation of museum multimedia applications: lessons from research. *Museum Management and Curatorship*, *17*, 173-187.

Ellin, E. (1969). Museums and the computer: An appraisal of new potentials. *Computers and the Humanities, 4*(1), 25-30.

Evans, J., & Sterry, P. (1999). Portable computers and interactive multimedia: A new paradigm for interpreting museum collections. *Archives and Museum Informatics, 13*, 113-126.

Giannini, T. (2006). Competencies for art museum librarianship: Teaching on location at the Watson Library, Metropolitan Museum of Art. In Ball, H. (Ed.), *Core competencies & core curricula for the art library and visual resources professions* (pp. 78-85). Ontario, CA: Art Libraries Society of North America.

Gill, T., Gilliland-Swetland, A., & Baca, M. (1998). *Introduction to Metadata: Pathways to Digital Information*. Los Angeles: Getty Research Institute.

Gilliland-Swetland, A., & White, L. (2004, June). Museum information professionals as providers and users of online resources. *Bulletin of the American Society for Information Science and Technology, 30*(5), 23-27.

Gladney, H., Mintzer, F., & Schiattarella, F. (1997, July/August). Safeguarding digital library contents and users: Digital images of treasured antiquities. *D-Lib Magazine, 3*(7). Retrieved October 1, 2006, from http://www.dlib.org/dlib/july97/vatican/07gladney.html

Hamma, K. (2004a). The role of museums in online teaching, learning, and research. *First Monday, 9*(5). Retrieved October 1, 2006, from http://firstmonday.org/issues/issue9_5/hamma

Hamma, K. (2004b, June). Becoming digital. *Bulletin of the American Society for Information Science and Technology, 30*(5), 11-13.

Harms, I. & Schweibenz, W. (2001). Evaluating the usability of a museum Web site. In D. Bearman & J. Trant (Eds.), *Museums and the Web 2001* (pp. 43-54). Pittsburgh, PA: Archives and Museum Informatics.

Hedstrom, M. & King, J.L. (2003). *On the LAM: Library, archive, and museum collections in the creation and maintenance of knowledge communities*. Paris, France: Organisation for Economic Co-operation and Development. Retrieved October 1, 2006, from http://www.oecd.org/dataoecd/59/63/32126054.pdf

Hermann, J. (1997). Shortcuts to Oz: Strategies and tactics for getting museums to the Emerald City. In K. Jones-Garmil (Ed.), *The wired museum: Emerging technology and changing paradigms* (pp. 65-91). Washington, D.C.: American Association of Museums.

Hertzum, M. (1998). A review of museum websites: In search of user-centered design. *Archives and Museum Informatics, 12*, 127-138.

Janes, R.R. (1997). *Museums and the paradox of change: A case study in urgent adaptation*. Calgary: University of Calgary Press.

Johnston, L. (1997). Imaging in museums: Issues in resource development. In K. Jones-Garmil (Ed.), *The wired museum: Emerging technology and changing paradigms* (pp. 93-114). Washington, D.C.: American Association of Museums.

Jones-Garmil, K. (Ed.). (1997). *The wired museum: Emerging technology and changing paradigms*. Washington, D.C.: American Association of Museums.

Jörgensen, C. (2004). Unlocking the museum: A manifesto. *Journal of the American Society for Information Science and Technology, 55,* 462-464.

Kavanagh, G. (Ed.). (1994). *Museum provision and professionalism*. London: Routledge.

Knell, S. (2003). The shape of things to come: Museums in the technological landscape. *Museum and Society, 1* (3), 132-146.

Koot, G-J. (2001). Museum librarians as information strategists. *INSPEL, 35*, 248-258.

Kravchyna, V. & Hastings, S. (2002). Informational value of museum web sites. *First Monday, 7*(2). Retrieved October 1, 2006, from http://www.firstmonday.org/issues/issue7_2/kravchyna/

Lanzi, E. (1998). *Introduction to vocabularies: Enhancing access to cultural heritage information*. Los Angeles: Getty Trust Publications.

Licklider, J.C.R. (1969). Computer graphics as a medium of artistic expression. In *Computers and their potential application in museums* (pp. 273-302). New York: Arno Press.

Lord, B., & Lord, G.D. (1997). *The manual of museum management*. Walnut Creek, CA: Altamira Press.

Lynch, C. (2002). Digital collections, digital libraries, and the digitization of cultural heritage information. *First Monday, 7*(5). Retrieved October 1, 2006, from http://www.firstmonday.org/issues/issue7_5/lynch/

MacDonald, G.F. (1991). The museum as information utility. *Museum Management and Curatorship, 10*, 305-311.

Martin, W., Rieger, R., & Gay, G. (1999). Designing across disciplines: Negotiating collaborator interests in a digital museum project. In D. Bearman & J. Trant (Eds.), *Cultural heritage informatics 1999* (pp. 83-90). Pittsburgh, PA: Archives and Museum Informatics.

Marty, P.F. (2005). So you want to work in a museum? Guiding the careers of future information professionals in museums. *Journal of Education for Library and Information Science, 46*, 115-133.

Marty, P.F. (2006a). Meeting user needs in the modern museum: Profiles of the new museum information professional. *Library & Information Science Research, 28*, 128-144.

Marty, P.F. (2006b). Finding the skills for tomorrow: Information literacy and museum information professionals. *Museum Management and Curatorship*, *21*, xxx-xxx.

Marty, P.F. (2007). The changing nature of information work in museums. *Journal of the American Society for Information Science and Technology*, *58*, xxx-xxx.

Marty, P.F., Rayward, W.B., & Twidale, M.B. (2003). Museum informatics. *Annual Review of Information Science and Technology, 37*, 259-294.

Ockuly, J. (2003). What clicks? An interim report on audience research. In D. Bearman & J. Trant (Eds.), *Museums and the Web 2003* (n.p.). Toronto, CA: Archives and Museum Informatics.

Orna, E., & Pettitt, C. (1998) *Information management in museums*. Aldershot: Gower.

Peacock, D. (2002). Statistics, structures, and satisfied customers: Using Web log data to improve site performance. In D. Bearman & J. Trant (Eds.), *Museums and the Web 2002* (pp. 157-166). Pittsburgh, PA: Archives and Museum Informatics.

Perkins, J. (2001). A new way of making cultural information resources visible on the Web: Museums and the open archive initiative. In D. Bearman & J. Trant (Eds.), *Museums and the Web 2001* (pp. 87-92). Pittsburgh, PA: Archives and Museum Informatics.

Rayward, W.B. (1998). Electronic information and the functional integration of libraries, museums and archives. In E. Higgs (Ed.), *History and electronic artefacts* (pp. 207-224). Oxford: Oxford University Press.

Rayward, W.B., & Twidale, M.B. (2000). From docent to cyberdocent: Education and guidance in the virtual museum. *Archives & Museum Informatics*, *13*, 23-53.

Reed, P.A., & Sledge, J. (1988). Thinking about museum information. *Library Trends, 37*, 220-231.

Rinehart, R. (2001). Museums and the online archive of California. *Spectra, 29*, 20-27.

Rush, C., & Chenhall, R. (1979). Computer and registration: Principles of information management. In D. Dudley & I. Wilkenson (Eds.), *Museum registration methods* (pp. 319-339). Washington, D.C.: American Association of Museums.

Sayre, S. & Wetterlund, K. (2003). Addressing multiple audiences with multiple interfaces to the AMICO library. In D. Bearman & J. Trant (Eds.), *Museums and the Web 2005* (n.p.). Toronto, CA: Archives and Museum Informatics.

Schaller, D.T. & Allison-Bunnell, S. (2005). Learning styles and online interactives. In D. Bearman & J. Trant (Eds.), *Museums and the Web 2005* (n.p.). Toronto, CA: Archives and Museum Informatics.

Schoener, A. (1969). The electronic museum and information distribution. In *Computers and their potential application in museums* (pp. 359-366). New York: Arno Press.

Schwarzer, M. (2001, July/August). Art and gadgetry: The future of the museum visit. *Museum News*, 36-41.

Sherwood, L.E. (1997). Moving from experiment to reality: Choices for cultural heritage institutions and their governments. In K. Jones-Garmil (Ed.), *The wired museum: Emerging technology and changing paradigms* (pp. 129-152). Washington, D.C.: American Association of Museums.

Streten, K. (2000). Honored guests: Towards a visitor-centered web experience. In Bearman, D. & J. Trant (Eds.) *Museums and the Web 2000* (n.p.). Pittsburgh, PA: Archives and Museum Informatics.

Suchy, S. (2004). *Leading with passion: Change management in the 21st-century museum*. Walnut Creek, CA: Altamira Press.

Teather, L., & Wilhelm, K. (1999). Web musing: Evaluating museums on the Web from learning theory to methodology. In D. Bearman & J. Trant (Eds.), *Museums and the Web 1999* (pp. 131-143). Pittsburgh, PA: Archives and Museum Informatics.

Thomas, W.A. & Carey, S. Actual/virtual visits: What are the links? In D. Bearman & J. Trant (Eds.), *Museums and the Web 2005* (n.p.). Toronto, CA: Archives & Museum Informatics.

Thomas, S., & Mintz, A. (Eds.). (1998). *The virtual and the real: Media in the museum.* Washington, D.C.: American Association of Museums.

Trant, J., Bearman, D., & Richmond, K. (2000). Collaborative cultural resource creation: The example of the Art Museum Image Consortium. In D. Bearman & J. Trant (Eds.),

Museums and the Web 2000 (pp. 39-50). Pittsburgh, PA: Archives and Museum Informatics.

Vance, D. (1975). Museum computer network: Progress report. *Museologist, 135*, 3-10.

Wakkary, R. & Evernden, D. (2005). Museum as ecology: A case study analysis of an ambient intelligent museum guide. In D. Bearman & J. Trant (Eds.), *Museums and the Web 2005* (pp.151-164). Toronto, CA: Archives and Museum Informatics.

Wentz, P. (1995). Museum information systems: The case for computerization. In Fahy, A. (Ed.), *Collections management* (pp.198-210). London: Routledge.

Woodruff, A., Aoki, P.M., Grinter, R.E., Hurst, A., Szymanski, M.H., & Thornton, J.D. (2002). Eavesdropping on electronic guidebooks: Observing learning resources in shared listening environments. In D. Bearman & J. Trant (Eds.), *Museums and the Web 2002* (pp. 21-30). Pittsburgh, PA: Archives and Museum Informatics.

Zorich, D. (1997). Beyond bitslag: Integrating museum resources on the Internet. In K. Jones-Garmil (Ed.), *The wired museum: Emerging technology and changing paradigms* (pp. 171-202). Washington, DC: American Association of Museums.

Zorich, D. (1999). *Introduction to managing digital assets: Options for cultural and educational organizations.* Los Angeles: Getty Trust Publications.

Zorich, D. (2000, January/February). Copyright in the digital age. *Museum News*, 36-45.

	Q1: What They Know			*Q2: What They Do*			*Q1 vs. Q2*		*Q3: What They Need*			*Q1 vs. Q3*		*Q2 vs. Q3*	
Topic	**Q1a**	**Q1b**	**R1**	**Q2a**	**Q2b**	**R2**	**R12**	**R21**	**Q3a**	**Q3b**	**R3**	**R13**	**R31**	**R23**	**R32**
IR	74	33	43	70	29	38	94	99	40	27	57	47	87	49	85
IO	77	39	49	76	51	64	94	95	54	40	62	63	90	62	87
IM	78	30	36	76	57	67	93	96	59	40	59	66	87	65	83
CT	71	34	47	66	46	62	84	91	59	39	56	69	83	69	77
DT	64	14	21	66	61	80	89	87	72	51	65	79	71	80	74
IT	41	14	28	37	33	73	83	92	62	49	72	70	46	69	41
IP	54	17	30	49	36	62	85	92	55	32	54	66	65	69	63
EM	34	20	47	33	22	56	84	88	43	36	67	56	44	60	46
CI	56	13	22	55	47	76	89	92	59	33	53	74	71	72	67

Table 1: Results for Museum Professionals (n=132), Expressed as Percentages (%)

	IR	IO	IM	CT	DT	IT	IP	EM
IO	0.44							
IM	0.22	0.44						
CT	0.11	0.16	0.19					
DT	0.27	0.30	0.37	0.23				
IT	-0.23	-0.16	-0.12	0.12	0.04			
IP	0.20	0.20	0.28	0.08	0.26	0.09		
EM	-0.07	-0.09	-0.12	0.07	-0.07	0.31	0.12	
CI	-0.01	-0.02	0.04	-0.12	-0.08	0.12	0.19	0.28

Table 2: Pearson correlations for Q1a responses

	IR	IO	IM	CT	DT	IT	IP	EM
IO	0.47							
IM	0.39	0.55						
CT	0.25	0.30	0.22					
DT	0.35	0.49	0.41	0.29				
IT	-0.21	-0.08	-0.08	0.22	0.05			
IP	0.08	0.13	0.16	0.06	0.22	0.24		
EM	-0.10	-0.13	-0.13	0.09	-0.08	0.41	0.29	
CI	0.10	0.02	0.09	0.06	0.02	0.12	0.27	0.24

Table 3: Pearson correlations for Q2a responses

	IR	IO	IM	CT	DT	IT	IP	EM
IO	0.44							
IM	0.36	0.52						
CT	0.20	0.21	0.27					
DT	0.26	0.19	0.30	0.26				
IT	0.07	-0.03	0.09	0.25	0.21			
IP	0.25	0.23	0.24	-0.01	0.19	0.03		
EM	0.06	0.07	-0.05	0.01	-0.04	0.20	0.20	
CI	-0.02	-0.01	-0.05	0.07	-0.06	0.01	0.14	0.23

Table 4: Pearson correlations for Q3a responses

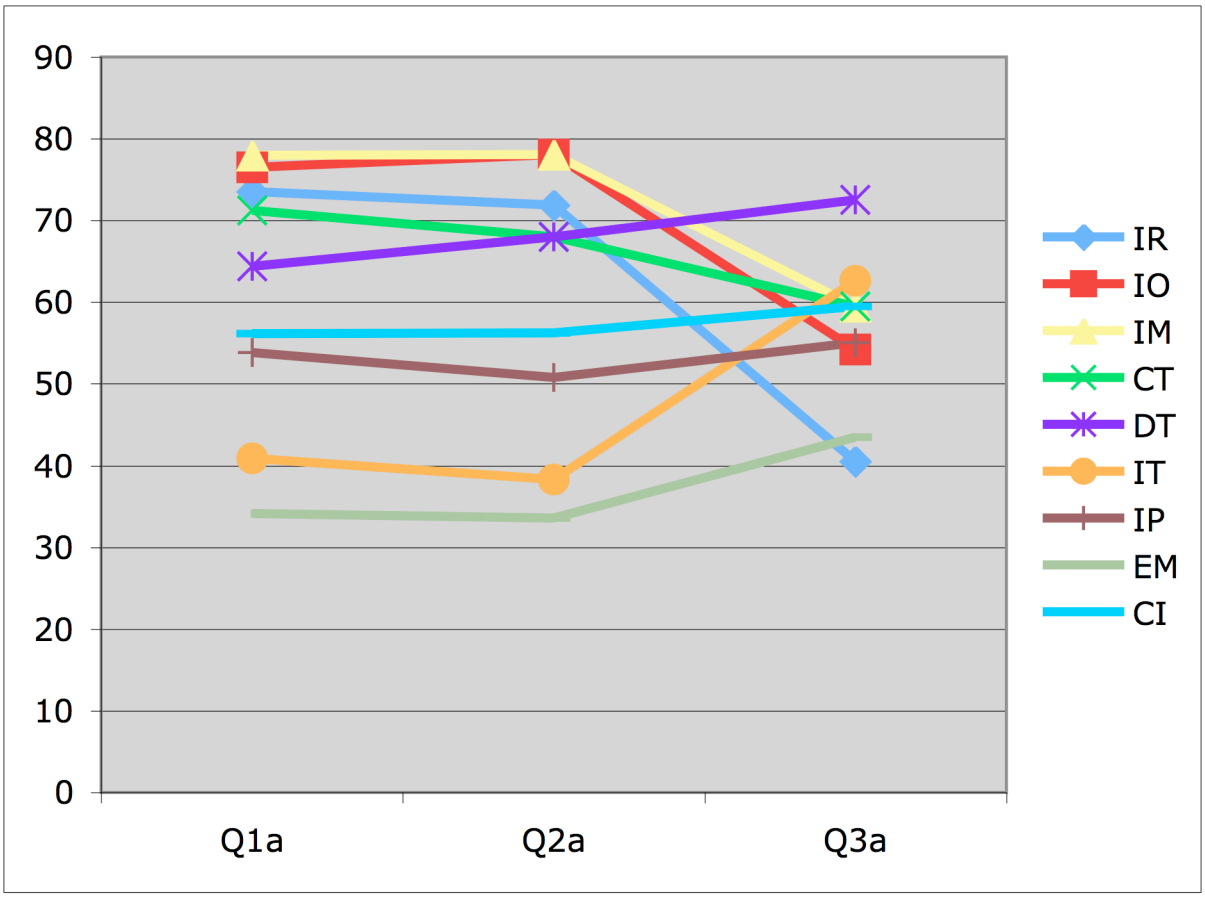

Figure 1: Museum Professional Involvement with LIS Topics