AN EXAMINATION OF THE ADOPTION OF PRESERVATION METADATA IN CULTURAL HERITAGE INSTITUTIONS: AN EXPLORATORY STUDY USING DIFFUSION OF INNOVATIONS THEORY

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Digital preservation is a significant challenge for cultural heritage institutions and other repositories of digital information resources. Recognizing the critical role of metadata in any successful digital preservation strategy, the Preservation Metadata Implementation Strategies (PREMIS) has been extremely influential on providing a "core" set of preservation metadata elements that support the digital preservation process. However, there is no evidence, in the form of previous research, as to what factors explain and predict the level of adoption of PREMIS. This research focused on identifying factors that affect the adoption of PREMIS in cultural heritage institutions.

This study employed a web-based survey to collect data from 123 participants in 20 country as well as a semi-structured, follow-up telephone interview with a smaller sample of the survey respondents. Roger's diffusion of innovation theory was used as a theoretical framework. The main constructs considered for the study were relative advantage, compatibility, complexity, trialability, observability, and institution readiness. The study yielded both qualitative and quantitative data, and analysis showed that all six factors influence the adoption of PREMIS in varying degrees. Results of a regression analysis of adoption level on the six factors showed a statistically significant relationship. The R^2 value for the model was .528, which means that 52.8% of the variance in PREMIS adoption was explained by a combination of the six factors. Considering the complexity of issue, this study has important implications for future research on preservation metadata and provides recommendations for researchers and stakeholders engaged in metadata standards development efforts.

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TABLE OF CONTENTS

Page

LIST OF TABLES

Table Page

LIST OF ILLUSTRATIONS

CHAPTER 1

INTRODUCTION

Information resources are increasingly produced digitally in a wide variety of formats ranging from simple text to complex multimedia resources. The synergies of numerous emerging trends are shaping creation, access, use, and preservation of information resources. This study uses diffusion of innovation (DOI) theory to explore the adoption of preservation metadata in a selected group of cultural heritage institutions.

The volume of the Web continues to grow dramatically and the growing shift from paper to digital is widely recognized. As noted by Waller and Sharp (2006), the continuing pace of development in digital technologies opens up many exciting new opportunities in both our leisure time and professional lives. The School of Information Management and Systems at the University of California has estimated that during 2002, print, film, magnetic, and optical storage media produced about 5 exabytes (10^{18} bytes) of new information. Ninety-two percent of the new information was stored on magnetic media, primarily on hard disks (Lyman & Varian, 2003).

Similarly, commercial publishers estimate that most if not all of their journal content is available in digital format. The British Library has estimated that by the year 2020, a mere 10% of UK research monographs is expected to be available in print alone, while 40% of new titles will be produced in digital format only and a further 50% will be available in both print and digital (Beagrie, 2006).

The diverse and ever-expanding digital information resources on the Web have been produced without much regard to long-term access and preservation issues. In a recent preservation needs assessment report, Waller and Sharp (2006) mentioned that in many cases little thought has been given to how these digital files will be accessed in the future, even within the next decade or so. Beagrie (2003) stressed that significant effort needs to be put into developing persistent information infrastructures for digital materials if they are to be useful and usable.

The growth in the development of and research on digital libraries and digital archives around the world has led to an accelerated search for suitable methods of managing digital information sources in this complex and shifting information landscape. The literature reflects a range of opinions on different issues of digital resource management across different communities. Emphasis is placed on the potential role of metadata in supporting many needs of the digital environment. Since the underlying principle for metadata is to improve the management and access to information, most researchers (Moen, 2001; Sutton, 1999; Zeng, 1999; among others), agree that application of metadata can satisfy digital information resource discovery and use, which are the most pressing needs of the users.

Similarly, Ercegovac (1999) emphasized the role of metadata in seamlessly facilitating access to relevant information regardless of its type (e.g., visual and museum objects, historical data, cultural heritage, and scientific data), scholarly tradition (e.g., librarians, archivists, scientists, etc.), and location. Despite the fact that most metadata research puts more emphasis on resource discovery, a small breakthrough has been achieved in the past few years related to preservation issues. A number of researchers

(Besser, 2002; Day, 2001; Lazinger, 2001; Ross & Hedstrom, 2005; among others) noted that the problem of ensuring long-term access to digital information sources is compounded by the fact that most of the sources are not properly organized or do not have proper descriptions, as one would find in a library environment. Most agree that extensive metadata is the best way of minimizing the risk of digital objects becoming inaccessible.

Digital Preservation and Metadata

In today's digital library environment in which diverse collections are usually integrated and linked from a single system, the persistence of digital information resources is an important consideration. Addressing the preservation and long-term access issues for these huge and ever-expanding collections of digital information is a significant challenge for libraries, archives, museums, government agencies, research institutions, and other repositories of digital information resources.

According to Day (2006), digital preservation can be described as the range of activities required to ensure that digital objects retain quality and remain accessible for as long as they are needed. Despite the growing ubiquity of digital information, the long-term preservation of information in digital form is far from a simple task. As outlined by Hedstrom (2003), the challenges of digital preservation are multifaceted, involving a mixture of technical and organizational issues. Most digital preservation researchers (Beagrie 2006; Besser, 2000; Connaway, O'Neill, & Prabha, 2006; Kenny & Rieger, 2000) agree that none of the current preservation strategies (normalization, migration, emulation, among other most commonly used methods) is ideal for the complex

preservation challenges that confront digital libraries. The existence of multiple approaches reflects the reality that the best preservation strategies that will work best for all or particular objects are not known yet.

As noted by Beagrie (2006) and Lavoie and Gartner (2005), digital preservation strategy is a particular technical approach to ensuring long-term access that outlines a policy framework applicable to all stages in the life cycle of a digital resource: creation, use, management, and preservation. Day (2006) summarizes the digital preservation challenges and describes a key point: whichever preservation strategy (or combination of strategies) is chosen, it is critical that the purpose of any strategy will be to ensure that the significant properties of preserved objects can be retained. He also asserts that the key to the successful implementation of all preservation strategies will be the capture, creation, maintenance, and application of appropriate metadata. This assertion has been supported by a series of conferences and workshops participants. For example, in the 2003 conference on Research Challenges in Digital Archiving and Long-term Preservation, participants emphasized segmenting the broad problem of long-term preservation into reasonable research objectives: setting priorities, mobilizing resources, and encouraging research to address this problem. Similarly, during the 2006 Web Archiving conference, participants assessed the current status of digital preservation and identified preservation metadata as one of the preservation tools most needed for ensuring digital resource longevity.

Accordingly, a number of national and international projects and initiatives considered current practices and emerging developments in the evolving information and technology environment and attempted to address the digital preservation issues in

general and the potential of metadata in preservation management activities in particular. Among other standards and best community practices, the reference model for an open archival information system (OAIS) for example has been extremely influential on the development of preservation metadata standards.

Open Archival Information System (OAIS)

OAIS was developed by the Consultative Committee for Space Data Systems (CCSDS) to provide a framework for the standards related to long-term preservation within the space science community. OAIS was created with the view that the reference model would be widely applicable to long-term preservation in any context, primarily, but not exclusively, digital. The Reference Model exists at an abstract level, providing a conceptual framework for raising fundamental questions regarding the long-term preservation of digital materials – questions that cut across domain-specific implementations (Lavoie, 2004).

In her comprehensive OAIS evaluation report, Allinson (2006) stated that OAIS indeed provides the "abstract task model" and provides some conceptual ideas for the "roles and activities that humans and computer systems are respectively to play and the workflow or processes involved" (p.13). The model usefulness in providing a common terminology is immediately apparent. As noted by Allinson (2006), OAIS terminology is gaining ground across a number of communities, with references to SIPs (submission information packages), AIPs (archival information packages), and DIPs (dissemination information packages).

The Preservation Metadata Implementation Strategies (PREMIS)

A growing number of studies, projects, and initiatives have built upon the foundation laid by the OAIS reference model and have examined the potential of metadata in preservation management activities. Some of the leading and high-level preservation metadata initiatives specifically designed to address the potential of metadata in preservation management activities and which provide much needed information to support the digital preservation strategies include: the National Library of Australia's Preserving Access to Digital Information (PADI) initiative, European research projects including NEDLIB (Networked European Deposit Library), CEDARS (CURL [Consortium of University Research Libraries], Exemplars in Digital Archives), and the US Research Library Group (RLG) and Online Computer Library Center (OCLC). These pioneering national and regional initiatives and taskforces defined the attributes of a trusted cultural heritage digital archive and gave useful indications of some of the individual metadata elements that need to be captured to help ensure some degree of digital preservation.

However, considering the wide range of functions that preservation metadata is expected to support; many researchers acknowledge that the recommendation of standards is far from simple task. For example Day (2006) noted that the situation is complicated further by the knowledge that different kinds of metadata will be required to support different digital preservation strategies and that the metadata standards themselves will need to evolve over time. Accordingly, in early 2000, OCLC and RLG

convened an international working group to produce a unified metadata framework to Support the Preservation of Digital Objects (OCLC/RLG Working Group on Preservation Metadata, 2002).

Following publication of the metadata framework, OCLC and RLG commissioned a further working group, Preservation Metadata Implementation Strategies (PREMIS), to investigate the issues of implementing preservation metadata in more detail. The focus of the PREMIS group was on the practical aspects of implementing preservation metadata in digital preservation systems. Specifically, the twin objectives of PREMIS were to:

1. Develop a core preservation metadata set, supported by a data dictionary, with broad applicability across the digital preservation community.
2. Identify and evaluate alternative strategies for encoding, storing, and managing preservation metadata in digital preservation systems (PREMIS Working Group, 2005).

The PREMIS working group followed the activities of the first Preservation Metadata Framework Working Group and built upon the 2002 metadata framework document and many other metadata specifications, issuing its proposal for core preservation metadata in May 2005. The PREMIS Data Dictionary for Preservation Metadata publication (version 1.0) translated the earlier metadata framework into a set of implementable semantic units and identified core digital preservation metadata supported by practical examples and an XML schema to enable more efficient transfer of metadata between different organizations.

Table 1

Timeline of Major PREMIS Development Activities

Date	Events/Activities	Description
April 2008	The PREMIS Editorial Committee released the revised data dictionary (PREMIS 2.0).	Incorporated numerous changes to version 1.0, based on the suggestions made by early adopters and others.
August 2006	The Maintenance Activity formed a ten-person PREMIS Editorial Committee to coordinate and approve future revisions of the Data Dictionary and XML schema.	The Committee members are experts from a variety of institutions and countries, and among other things would be responsible for coordinating and approving revisions to the PREMIS DD.
May 2005	PREMIS Published the final report: *Data Dictionary for Preservation Metadata: Final report of the PREMIS Working Group*	The PREMIS working group completed its activities in May 2005 with the release of the final report (version 1.0).
September 2004	PREMIS published its first report: *Implementing Preservation Repositories for Digital Materials: Current Practice and Emerging Trends in the Cultural Heritage Community*	Survey got 49 responses from 13 countries (28 libraries, 7 archives, 3 museums, and 11 others), and provided snapshot of current practice and use of preservation metadata:
June 2003	A second working group, PREMIS (Preservation Metadata Implementation Strategies), was formed	OCLC/ RLG sponsored working group, PREMIS, to address implementation issues associated with preservation metadata.
June 2002	Publication of: *A Metadata Framework to Support the Preservation of Digital Objects*	It is a comprehensive description of the types of information falling within the scope of preservation metadata.
January 2001	Publication of: *Preservation Metadata for Digital Objects: A Review of the State of the Art*	A white paper by OCLC/RLG Working Group on Preservation Metadata.
2001-2002	OCLC and RLG convened an international working group of experts.	The group developed a metadata framework to support long-term retention.
March 2000	OCLC and RLG announced their commitment to collaborate on identifying best practices for the long-term retention of digital objects.	A major focus of this cooperation was to promote consensus in best practices for the use of metadata to support of digital preservation processes.

The PREMIS Working Group concluded its activities in 2005. The PREMIS is maintained by the PREMIS Editorial Committee and is currently in version 2.0, which was issued in April 2008. There is a PREMIS Implementers' Group (PIG) discussion forum hosted by the Library of Congress, and unmoderated listserv open to members of the PREMIS implementer community. Table 1 lists the major development activities of the PREMIS. The PREMIS data model is discussed in chapter 2 and for a detail and comprehensive timeline of PREMIS activities, see Appendix-A.

Statement of the Problem

Digital preservation has been described as a grand challenge for the first decade of the twenty-first century (Day, 2006; Hedstrom, 2003; Lee & Tibbo, 2007; and Lynch, 2003). Libraries, archives, museums, government agencies, research institutions, and other repositories of digital heritages are developing and implementing various digital preservation methods at different rates. There has been ongoing research on the role of metadata in facilitating preservation activities by various national and international communities (Alemneh, Hastings, & Hartman, 2002; Besser, 2002; Lavoie, 2004; Research Library Group 2002).

There is an overwhelming consensus among experts that PREMIS provides required standards and best practices for the use of metadata in support of long-term preservation (Day, 2006; and Lavoie, 2008). Although PREMIS is becoming more popular among cultural heritage institutions, there is no evidence that explains and predicts the level of adoption. Understanding the rate of adoption in any given situation

requires analysis of factors that may facilitate the adoption and those that may operate as barriers to adoption.

The general problem addressed in this dissertation is the uncertainty related to the best ways of ensuring long-term access to digital resources and the viability of employing preservation metadata to facilitate the preservation activities. The specific problem addressed here is identifying and understanding main issues that may facilitate the adoption of PREMIS and those that may operate as barriers to adoption of PREMIS in cultural heritage institutions. This exploratory study uses a theoretical framework from Roger's diffusion of innovation theory.

Significance of the Study

A literature review in the area of digital preservation indicates that the adoption of preservation metadata has not been studied in depth. Given the complexity of digital preservation challenges, and recognizing the potential role of preservation metadata, the findings of the study offer a better understanding of factors affecting adoption of preservation metadata in relation to cultural heritage institutions. Since research on adoption of preservation metadata is lacking, the outcome of the research contributes to the knowledge base by providing stakeholders with an analysis of the factors affecting adoption of PREMIS in the cultural heritage institutions.

Various researchers have examined the diffusion of information technologies and related innovations using the framework from the diffusion of innovations theory. Digital preservation metadata is part of digital technology innovation, and it would be expected that factors which have been found to be related to other digital technology innovations

would also explain the adoption of PREMIS in the cultural heritage institutions. Diffusion of innovations theory may also offer a way to understand why some innovations are accepted and adopted rapidly and others only with difficulty, despite strong evidence of their effectiveness.

Research Questions

To identify factors that affect PREMIS adoption and gain a broad understanding of issues that influence decision-making process in the cultural heritage institutions, the following research questions were addressed:

RQ1: What are the factors (i.e. attributes in the diffusion of innovations theory) that affect the adoption of PREMIS across diverse cultural heritage institutions?

RQ2: What influence did PREMIS have on the decision to adopt preservation metadata schemes and on current practices of preservation metadata management in the cultural heritage institutions?

RQ3: Among the diverse cultural heritage institutions that adopted or plan to adopt PREMIS, are there commonalities in factors that may affect the decision-making process? Are there differences by type of institution?

These research questions provide the framework for identifying the possible factors that may affect the adoption of PREMIS across the diverse cultural heritage institutions.

Delimitations of the Study

This study mainly dealt with the investigation of factors that affect adoption of PREMIS in cultural heritage institutions. Although other widely adopted preservation metadata approaches were identified, this exploratory research was only look at the factors specifically related to the adoption on PREMIS in relation to cultural heritage institutions. It is hoped that future research could benefit from the current work by expanding the scope to adoption of other preservation metadata schemes in other communities.

Purpose of the Study

The purpose of this exploratory research is to identify factors that affect adoption of preservation metadata, specifically PREMIS, in cultural heritage communities using the theoretical framework provided by the diffusion of innovations theory. The diffusion of innovations theory provides a model for conceptualizing the acceptance of PREMIS in a cultural heritage community. Bradford and Florin (2003) and Buonanno et al. (2005) say that understanding adoption of innovation in any given situation requires identification and analysis of factors that may facilitate the adoption and those that may operate as barriers to adoption.

Given the challenges of long-term access, and considering the key role of preservation metadata in any digital preservation strategies, this study also provide the cultural heritage communities with information to assist them in their decision making process when considering the adoption of preservation metadata.

Definition of Terms

- **Cultural heritage institutions**: for the purpose of this study, the term 'cultural heritage institutions' refers to libraries, museums, historical societies, archives, and other institutions that have responsibilities for preserving and providing long-term access to accumulated cultural heritage. According to Kravchyna (2004), heritage is the legacy of physical artifacts and intangible attributes of a group or society that are inherited from past generations, maintained in the present and bestowed for the benefit of future generations. As noted by Bishoff and Allen (2004), most cultural heritage institutions are mission-driven: their primary purpose is to support and promote the public good. Nonprofit organizations generally do not stray from their missions in order to generate additional revenue streams. However, none of this exempts or isolates these organizations from many of the same strategic or operational issues faced by for-profit organizations. What is different, according to Bishoff and Allen (2004), are the issues nonprofit institutions, and in particular, cultural heritage institutions, face in considering sustainable approaches to the management of their intellectual assets, both digital and physical.
- **Diffusion of innovations**: Everett Rogers formalized the diffusion of innovations theory in a 1962 book titled "Diffusion of Innovations." According to Rogers (2003), diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. One of the most robust findings about innovation diffusion is that adoption can be characterized as a normal

distribution, or bell curve. Using the normal distribution model, Rogers identified five major categories of individual adopters: innovators, early adopters, early majority, late majority, and laggards. Innovation and diffusion research provides a longstanding tradition of research on technological change. The original diffusion research was done as early as 1903 by the French sociologist Gabriel Tarde who plotted the original S-shaped diffusion curve. The rate of adoption, or diffusion rate, has become an important area of research to many disciplines (Rogers 2003).

- **Preservation metadata**: is information that supports and documents the long-term preservation of digital resources. According to Lavoie and Gartner, (2005), preservation metadata helps make an archived digital object self-documenting over time, even as the intellectual, economic, legal, and technical environments surrounding the object are in a constant state of change. Preservation metadata addresses, among other issues, a digital object's*:*

  - Provenance *(*documenting the custodial history of the object)

  - Authenticity (validating that the digital object is in fact what it purports to be and has not been altered in an undocumented way)

  - Preservation activity (documenting the actions taken to preserve the digital object and any consequences of these actions that impact its look, feel, or functionality)

  - Technical environment (describing the technical requirements, such as hardware and software needed to render and use the digital object)

-Rights management (recording any binding intellectual property rights that may limit the repository's ability to preserve and disseminate the digital object over time, Lavoie & Gartner, 2005).

Organization of the Study

This dissertation deals with the explanation of PREMIS adoption in cultural heritage institutions. The subject of research is introduced in the first chapter. This study falls within two fields of research: innovation adoption research and digital preservation research. In light of the scope of the investigation, the second chapter includes a review, analysis and synthesis of existing literature on innovation adoption in the context of digital preservation metadata. The research approach and main research questions are presented in chapter 3. Next, chapter 4 analyzes the data and elaborates on the central concepts in this study. Finally, in chapter 5, the research questions are revisited to draw conclusions from the study and describe the implications for future research as well as reflect on its limitations. Figure 1 summarizes the overall lay-out and design of the dissertation.

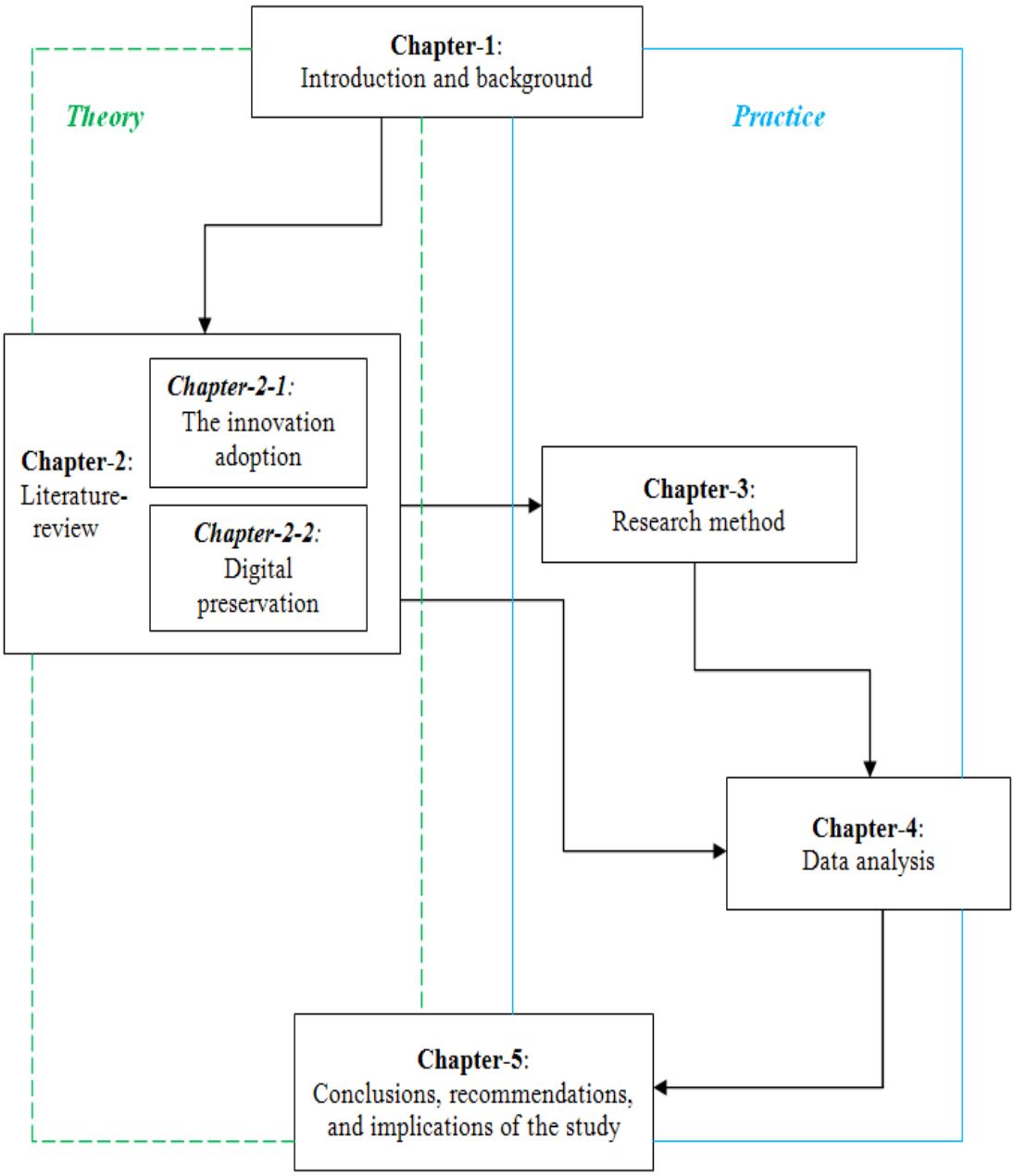

Figure 1. Organization of the dissertation.

Summary

Today the entire information landscape has changed and continues to change at a breathtaking pace. Digital technologies are shaping creation, management, access, and preservation of information in ways that are so profound that traditional methods may no longer be effective. The main technical problems of digital preservation relate to inadequate media longevity, rapid hardware obsolescence, and dependencies on particular software products. In addition to technological issues, responsible and viable preservation planning for digital materials need to address various issues, such as policy, economic, and organizational issues.

Different communities are developing and implementing various digital preservation methods at different rates. Considering the complex set of challenges, many researchers (Besser, 2002; Day, 2006; and Hedstrom, 2003) agree that there are no effective preservation methods or tools that work for all communities or types of resources. There is a fundamental need to know more about digital preservation in general. However, most agree that metadata plays a significant role in any preservation activities. Therefore, it is critical to have a deeper understanding of the factors which affect the adoption of preservation metadata for the purpose of managing digital resources for long-term access and use.

This chapter introduced some of the digital preservation issues and the range of managed activities that are necessary to ensure long-term access, emphasizing the critical role of metadata as an enabling tool in any successful preservation strategy. In addition, this chapter provided a brief introduction to the study. The specific purpose of this study

was to understand the broad range of factors that affect the adoption of preservation metadata in cultural heritage institutions.

Chapter 2 presents an investigation and in-depth discussion of different theoretical perspectives including review of diffusion of innovation theory, current digital preservation activities, preservation metadata and related best community practices initiatives.

CHAPTER 2

REVIEW OF THE LITERATURE

In this chapter, a review of the literature pertinent to the digital preservation context is presented to set a theoretical framework. Various researchers have examined the adoption of information technologies and standards using the framework from the diffusion of innovations theory (DOI). Digital preservation metadata is part of digital technology innovation, thus it would be expected that factors which have been found to be related to other digital technology innovations would also explain the adoption of preservation metadata in the cultural heritage communities.

The literature review is divided into two main sections. The first section includes an overview of the existing knowledge on the diffusion and adoption of innovation literature. In the second section some perspectives of digital preservation activities in the cultural heritage communities will be discussed. The discussion focuses on the preservation metadata aspects of the various national and international projects and initiatives.

Diffusion and Adoption of Innovation: Theoretical Framework

Innovation and diffusion research provide a longstanding tradition of research on technological change. Rogers (2003) was one of the pioneers who mapped out the problem space of adoption and diffusion theory. According to Rogers (2003), diffusion is

the process by which an innovation is communicated through certain channels over time among the members of a social system. In his famous and comprehensive book *Diffusion of Innovations*, first published in 1960 and now in its fifth edition, Everett Rogers summarizes the four main elements that are present in the diffusion of innovation process. Those four main elements are:

i. *The innovation* - an idea, practice, or object that is perceived as new by an individual or the adopter.

ii. *Communication channels* - the means by which messages get from one individual to another. Rogers (2003) defines communication as the process by which participants create and share information with one another in order to reach a mutual understanding.

iii. *Time* –the three time factors are:

(a) the innovation-decision process,

(b) the relative time with which an innovation is adopted by an individual or group, and

(c) the innovation's rate of adoption.

iv. *Social system* - a set of interrelated units that are engaged in joint problem solving to accomplish a common goal. The members or units of a social system may be individuals, informal groups, organizations and/or subsystems.

DOI theory (Rogers, 2003) can be divided into three main components: The characteristics of an innovation, the innovation-decision process, and Adopter characteristics.

The Characteristics of an Innovation

Bates et al. (2007) state that different innovations have different probabilities of adoption and the characteristics of an innovation have an impact on the likelihood of acceptance and adoption. According to Rogers (2003), potential adopters judge an innovation based on their perceptions regarding five attributes of the innovation. These attributes are:

1. Relative advantage—the degree to which an innovation is perceived as better than the idea that it supersedes.

2. Compatibility—the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters.

3. Complexity—the degree to which an innovation is perceived as difficult to understand and use.

4. Trialability—the degree to which an innovation may be experimented with on a limited basis.

5. Observability—the degree to which the results of an innovation are visible to others.

Innovation-Decision Process

The innovation-decision process comprises a series of stages through which potential adopters pass as they move from seeking information about the innovation, to making a decision to adopt or reject, and finally, to confirming their adoption decision (Rogers, 2003). These stages are:

1. Knowledge—an individual learns of the innovation's existence and gains some understanding of how it functions.

2. Persuasion—an individual forms a favorable or unfavorable attitude toward the innovation.

3. Decision—an individual engages in activities that lead to a choice to adopt and make full use of the innovation or to reject the innovation.

4. Implementation—an individual puts an innovation to use.

5. Confirmation—an individual seeks reinforcement of an innovation decision that has already been made.

It should not be assumed that the diffusion and adoption of all innovations are necessarily desirable; the same innovation may be desirable for one adopter in one situation but undesirable for another potential adopter in a different situation (Rogers, 2003).

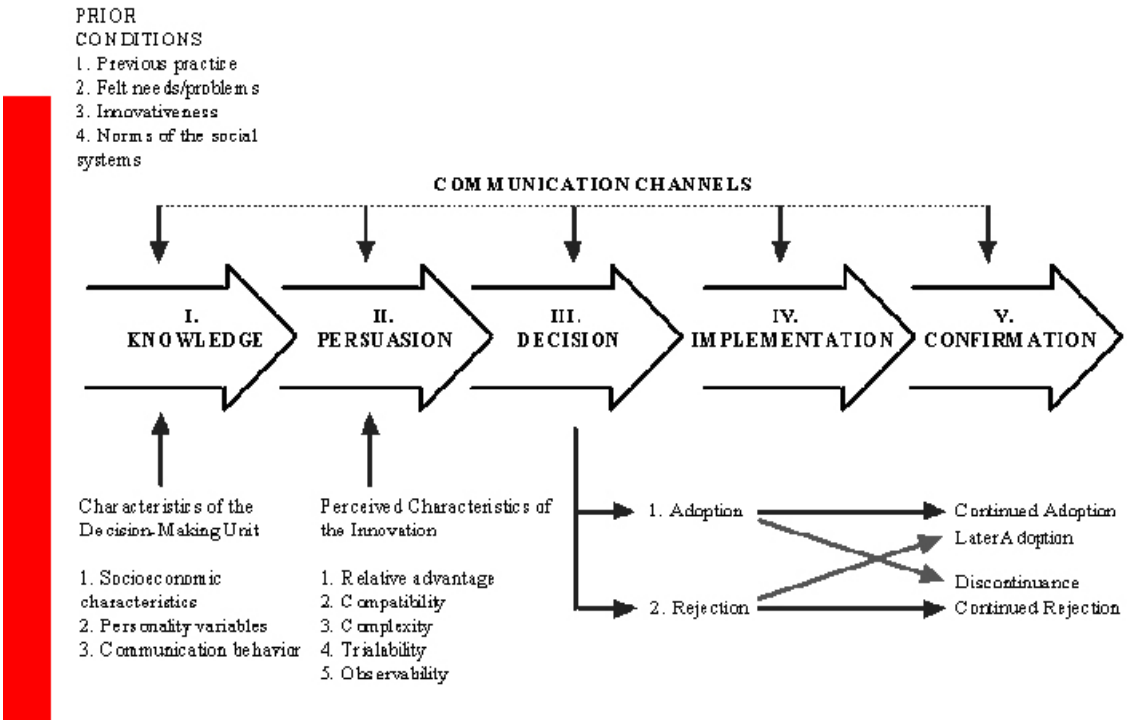

Figure 2. Stages in the innovation-decision process (Rogers, 2003).

As summarized in Figure 2, once an innovation comes to the early attention of a community, each subsequent prospective adopter familiarizes himself/herself with it and gains some knowledge, and goes through the first stage of comprehension of the innovation. In the context of this study, potential adopters in the cultural heritage institutions may ask what preservation metadata and PREMIS are all about and may try to find, albeit implicitly, justifications for its adoption.

From its comprehension of the innovation and knowledge gained about it, the institution may consider whether and when to adopt it. Again, as noted by Swanson (2001), depending on its specific situations, each cultural heritage institution may consider reasons why or why not to undertake adoption of PREMIS, and, if it should, when the suitable time is to do it. At this stage, institutional readiness is a key factor. If

an institution adopts early, could it gain a competitive advantage? If it adopts late, with the majority, is it more likely to be successful? Rogers (2003) noted that the innovation may not be appropriate for later adopters or "laggards." In this regard, several of the institutions that Lee (2005) surveyed had valid reasons for opting not to use the Open Archival Information System (OAIS) reference model.

The next step in the innovation-decision process is implementation: should the institutions decide in favor of the innovation and commit monetary and human resources to it? This is a stage where the 'when' question is asked but typically focuses on how adoption is to be accomplished. Some questions institutions might consider regarding adoption are: When should institutions have the PREMIS system up and running? How should they make it happen? Should they take a "big bang" approach and implement the full PREMIS system at once, or shall they take some phased approach (Brown & Vessey, 2000)? Do cultural heritage communities have the right "know- how" in their respective institutions to make the PREMIS adoption successful? In Table 2, Swanson (2001) summarized the major issues that need to be considered at each of the innovation-decision process stages.

Table 2

Summary of Issues at Each of the Innovation-Decision Process Stages (Swanson, 2001)

	What?	**Why?**	**When?**	**How?**	**Who?**
Comprehension	**X**	**X**			
Adoption		**X**	**X**		
Implementation			**X**	**X**	
Assimilation				**X**	**X**

Adopter Characteristics

Rogers (2003) defines categories of adopters as "the classifications of members of a social system on the basis of innovativeness" (p. 22). These categories include innovators, early adopters, early majority, late majority, and laggards. In each adopter category, individuals are similar in terms of their innovativeness. Innovativeness is "the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a system" (Rogers, 2003, p. 22). Similarly, Braak (2001) describes innovativeness as "a relatively-stable, socially-constructed, innovation-dependent characteristic that indicates an individual's willingness to change his or her familiar practices" (p. 144).

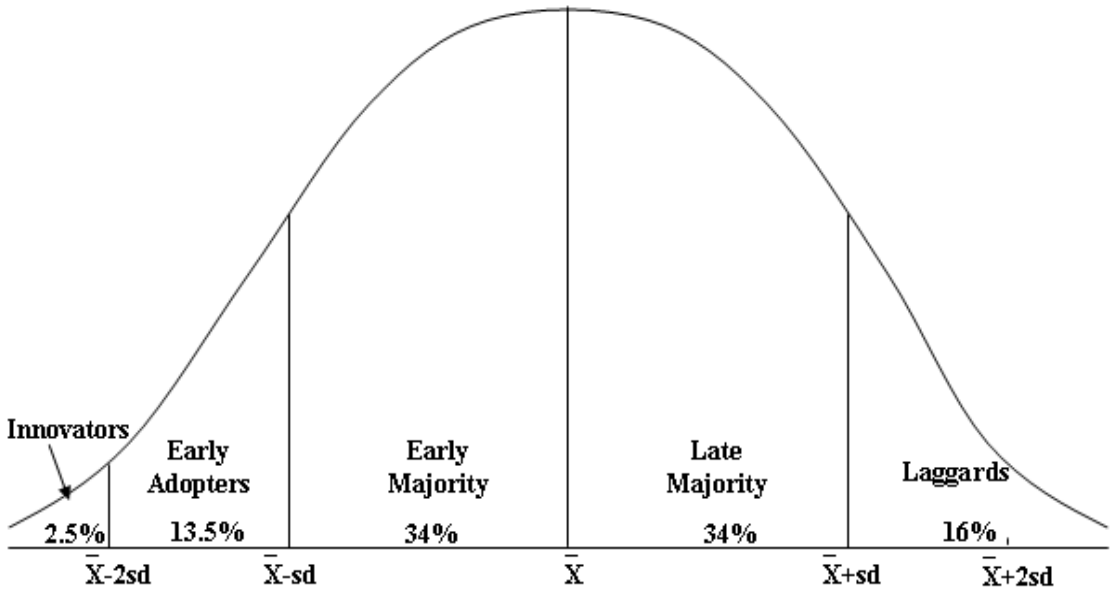

Figure 3. Adopter categorization on the basis of innovativeness (Rogers, 2003).

Rogers (2003) categorized adopters based on innovativeness. As Figure 3 shows, the distribution of adopters is a normal distribution. Any given population will generally fall into one of the five categories (from left to right: innovators, early adopters, early majority, late majority, and laggards) that define when and for what reasons the population will adopt or not adopt an innovation

Tarde (1903) was the first to look at diffusion and adoption of an innovation, observing that the process is a fundamental social action. He was also the first to observe that the rate of adoption of a new idea usually follows an S-shaped curve. As shown in Figure 4 and discussed by Rogers (2003), the curve represented a slow initial adoption of an innovation by an initial group; subsequently, a swift adoption by many others, where the opinion leaders of a social system influence adoption of the innovation by the rest of the social system; finally, the innovation taper off as the few remaining members of a social system decided to adopt an innovation.

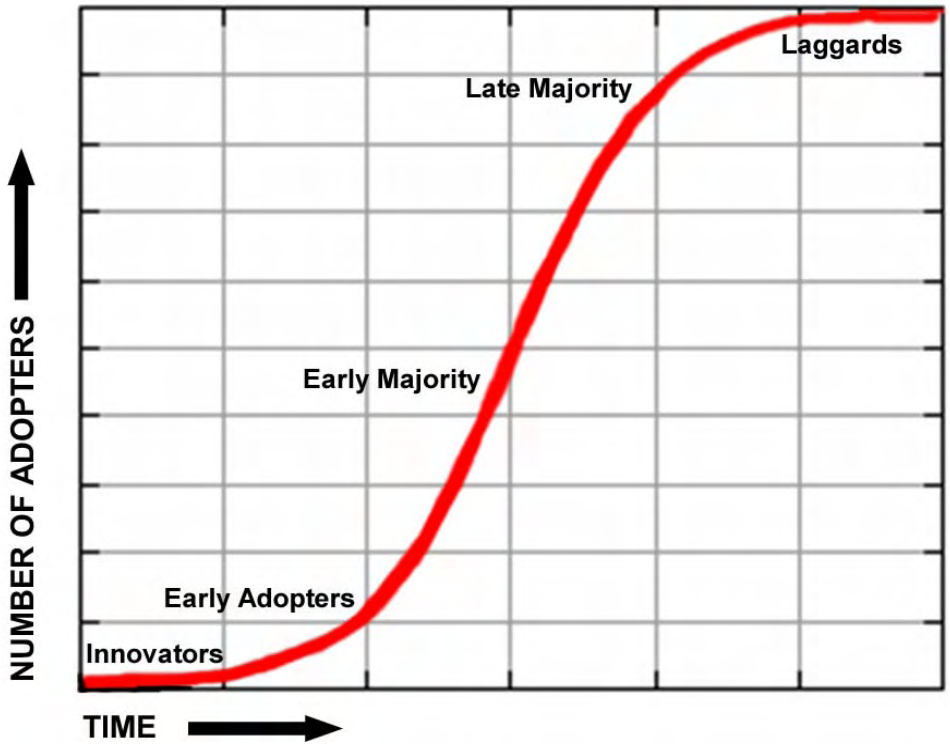

Figure 4. **S**-shaped curve of innovation adoption rate (Rogers, 2003 – modified).

Ryan and Gross (1943) were also among the earliest influential diffusion of innovation researchers. Beginning in the early 1940s, Bryce Ryan and Neal Gross had conducted what would become the seminal study of how Iowa farmers adopted hybrid corn. The hybrid seed corn was introduced in 1928. However, by 1941, about thirteen years after its first release, the innovation was adopted by almost 100 % of Iowa farmers. Ryan and Gross (1943) studied the reasons for the length of time for farmers to adopt and the processes and factors that influenced their adoption. They also found that the adoption of seed corn took the form of an S-shaped curve over time.

Rogers and Scott (1997) noted that the intellectual influence of the hybrid corn study reached far beyond the study of agricultural innovations and outside of the rural sociology tradition of diffusion research. Since the 1960s, the diffusion model has been applied in a wide variety of disciplines such as education, public health, communication, marketing, geography, general sociology, and economics. Diffusion studies in these various disciplines have ranged from the rapid diffusion of the Information Technology and Internet to the non-diffusion of the Dvorak keyboard in typewriters and computers (Rogers & Scott, 1997).

Bryant (2006) noted that efficiency and convenience are the primary differences between the S-shaped curve of adopters (Ryan & Gross, 1943), which plots the actual point in time of adoption (Figure 4), and the normal distribution categories of adopters of innovations (Figure 3: Rogers, 2003). Since the normal distribution allows adopters with similar degrees of innovativeness to be grouped together, it simplifies dealing with very large populations as well as giving a clearer picture of the adoption pattern of the population.

Innovators

The area to the left of the mean time of adoption of an innovation and beyond the two standard deviations below the mean point ($\bar{x}$ - 2sd) contains the first 2.5 % of adopters who are more likely to be innovators. For Rogers (2003), innovators were willing to experience new ideas. Thus, they should be prepared to cope with unprofitable and unsuccessful innovations, and a certain level of uncertainty about the innovation. Their risk-taking behavior requires innovators to have complex technical knowledge.

Early adopters

The area under the normal curve between one standard deviation ($\bar{x}$ - *sd*) and two standard deviations below the mean *(*$\bar{x}$ - *2sd*) includes the next 13.5 % of adopters who are early adopters (Bryant 2006). Rogers (2003) argued that since early adopters are more likely to hold leadership roles in the social system, other members go to them to get advice or information about the innovation. Similarly Sahin (2006) cited Light (1998) who contends that "leaders play a central role at virtually every stage of the innovation process, from initiation to implementation, particularly in deploying the resources that carry innovation forward" (p. 19). Thus, as role models, early adopters' attitudes toward innovations are paramount. Their subjective evaluations about the innovation reach other members of the social system and near-peers. Early adopters' leadership in adopting the innovation decreases uncertainty about the innovation in the diffusion process. As described by Rogers, "early adopters put their stamp of approval on a new idea by adopting it" (Rogers, 2003, p. 283).

Early majority

The area between the mean ($\bar{x}$) and the one standard deviation below the mean ($\bar{x}$ - sd) includes the next 34 % of adopters who are early majority adopters (Bryant, 2006). Rogers (2003) claimed that although the early majorities have a good interaction with other members of the social system, they do not have the leadership role that early adopters have. However, their interpersonal networks are still important in the innovation-diffusion process. As Figure 3 shows, the early majority adopts the innovation

just before the other half of their peers adopts it. As Rogers (2003) noted, they are deliberate in adopting an innovation and they are neither the first nor the last to adopt it.

Late majority

The area between the mean ($\bar{x}$) and one standard deviation above the mean ($\bar{x}$ + *sd*) includes the next 34 % of adopters, the late majority (Bryant, 2006). Similar to the early majority, the late majority includes one-third of all members of the social system who wait until most of their peers adopt the innovation. Although they are skeptical about the innovation and its outcomes, economic necessity and peer pressure may lead them to the adoption of the innovation. To reduce the uncertainty of the innovation, interpersonal networks of close peers should persuade the late majority to adopt it (Sahin, 2006). Then, "the late majorities feel that it is safe to adopt" (Rogers, 2003, p. 284).

Laggards

The area to the right of the mean time of adoption of an innovation and below one standard deviation above the mean *(*$\bar{x}$ + *sd*) includes the final 16 % of adopters who are laggards (Bryant, 2006). According to Rogers (2003), laggards have a traditional view and they are more skeptical about innovations and change agents than the late majority. Normally, they do not have a leadership role and their interpersonal networks mainly consist of other members in the social system from the same category. Because of the limited resources and the lack of awareness of innovations, they first want to make sure that an innovation works before they adopt. Laggards tend to decide after looking at whether the innovation is successfully adopted by other members of the social system in

the past. Due to these characteristics, laggards' innovation-decision period is relatively long (Sahin, 2006).

Table 3 *Roger's (2003) and Moore's (2002) Adopter Categories*

	Roger's adopter categories	**Moore's adopter categories**	**Remark**
1	Innovators	Technology Enthusiasts	(2.5%) - venturesome; typically take risks by adopting new ideas first and moving beyond the norms.
2	Early Adopters	Visionaries	(13.5%) - respected, valued, and often opinion leaders; look for a fundamental breakthrough brought by the technology
3	Early Majority	Pragmatists	(34%) - deliberate decision-makers; usually well-connected socially but weigh the decision for a longer time than early adopters.
4	Late Majority	Conservatives	(34%) - skeptical, traditional; cautiously wait for uncertainty to be removed.
5	Laggards	Skeptics	(16%) - the last traditional group to adopt an innovation; typically suspicious.

Moore (1991, 2002) has built upon the normal distribution and relabeled Rogers' adopter categories to reflect the technology adoption life cycle in organizations. Table 3 summarizes both Rogers' (2003) and Moore's (2002) adopter categories.

The Chasm

According to Moore (2002), there are chasms between each of the groups. Moore's (2002) analogy of "crossing the chasm" is used extensively in the technology adoption literature. Bryant (2006) posits that one potential reason an innovation is not adopted is that it fails to cross the gaps or chasms between each group of adopters. Moore's (2002) proposition is that any new technology is quickly adopted by innovators and early adopters (visionaries), but there is a chasm to cross in order to get the more pragmatic majority to adopt the new technology. According to Moore (2002), a major gap or chasm separates the first 15 % of the population from the remaining 85 %. Figure 5 shows Moore's (2002) chasm as a normal distribution curve of adopter categories.

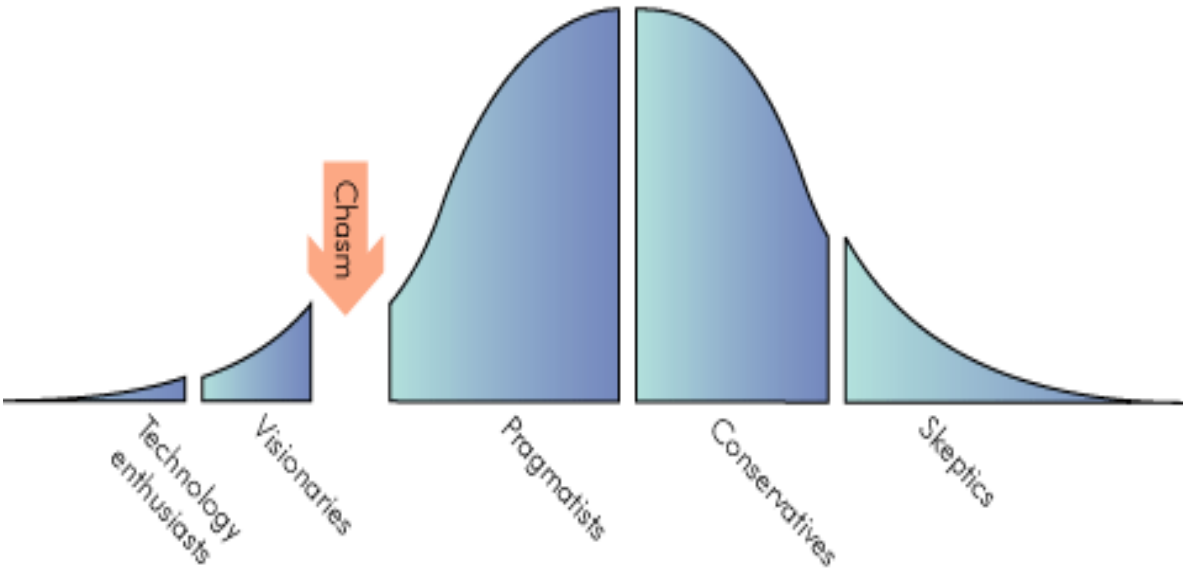

Figure 5. Chasm between innovator groups (Moore, 2002 - modified).

Although many DOI researchers (including Rogers, 2003) reject the existence of a chasm, several researchers have examined Moore's (1991, 2002) works in many different fields, disciplines, and contexts. Bryant (2006) and Geoghegan (1994) for example, examined the chasm in higher education and they believe that Moore's (2002) chasm is a significant, though under-appreciated, barrier to the diffusion and adoption of innovation to the remainder (85 %) of the population.

Many researchers (Bryant, 2006; Fichman & Kemerer, 1999; Geoghegan, 1994; Moore, 2002; among others) agree that if an innovation does not make it past this chasm, the innovation will have only reached 15 % of the population, which is not a successful adoption of an innovation by any means. For technology/innovation marketers and businesses, this is the real challenge – in many cases the development costs can only be recovered if the majority (critical mass) purchase and adopt the goods or services.

DOI Theory in Institutional Context

Many studies have used Rogers' DOI theory as their theoretical framework. Using quantitative and qualitative research methods, several authors (Allinson, 2006; Barker & Frolick, 2003; Buonanno et al., 2005; Fichman & Kemerer, 1997, 1999; Khoumbati, Themistocleous, & Irani, 2006; Moore & Benbasat, 1991; Sahin, 2006; among others) applied the model proposed by Rogers (2003) to examine factors that might influence adopters' motivation and decision to adopt new innovations in various sectors.

Different efforts have been made to identify and analyze the parameters affecting innovation adoption in organizational context. As summarized by Mantzana and Themistocleous, (2005), many previous technologies adoption studies identifies factors that influence innovation adoption in organizations. Most of the literature on organizational adoption stresses the importance of financial, organizational, and technological feasibility (Daft, 1978; Khoumbati et al., 2006, 2007). Top managers appear to place too much emphasis on financial feasibility. However, many researchers (in particular, Baker, 1987; and Finnie, 1988) have noted that beyond financial feasibility, one must consider organization feasibility, which is the capacity of the institution to adopt successfully. For example, does the institutional culture promote such change? Are the employees ready for and open to these changes? Are proposed changes in line with the current activities of the institution? Is it the right time to make them? Will these changes modify the employees' tasks, the organizational structure, and the relationship with other departments or units? All these questions need to be addressed before the final adoption decision, and when overlooked they can affect adoption negatively, even when financial feasibility is positive.

Some researchers slightly extended the DOI theory by coupling it with other theories and/or developing new theoretical insights. Many of these models represent attempts at applying general social and/or psychological models to the general topics of technology adoption. Some of these models are:

- The technology acceptance model (TAM) (Davis, 1989) based on the theory of reasoned action (TRA) (Ajzen & Fishbein, 1975),
- Theory of planned behavior (TPB) (Taylor & Todd, 1995; Mathieson, 1991) based on Ajzen's TPB (1991),
- Community of practice (CoP) (Oguz, 2007; Hildreth & Kimble, 2004) based on CoP (Wenger, 1998), and so forth.

The Technology Acceptance Model (TAM)

A number of studies use the technology acceptance model (TAM) in which perceived innovation attributes also play a central role. Davis et al. (1989) first introduced the TAM as a theoretical extension of the theory of reasoned action (TRA) (Ajzen & Fishbein, 1980). The model (see Figure 6) consists of three primary factors that predict computer use: perceived usefulness, perceived ease-of-use, and intention to use.

Perceived ease-of-use (EOU) is defined by Davis (1989) as the degree to which a person believes that using a particular system would be free from effort. Perceived usefulness (U) was defined as the user's "subjective probability that using a specific application system will increase his or her job performance within an organizational context" (Davis, et al. 1989, p. 985).

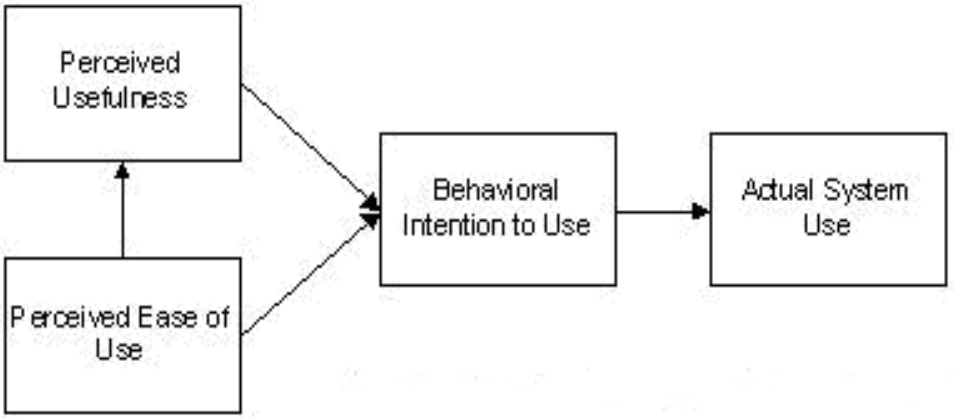

Figure 6. Technology Acceptance Model (TAM) (Davis et al., 1989; Venkatesh et al., 2003).

Several researchers have replicated Davis's original study (Davis, 1989) to provide empirical evidence on the relationships that exist between usefulness, ease of use and system use. As noted by Brown et al., (2002) and Venkatesh et al., (2003), researchers have simplified TAM by removing the attitude construct found in TRA from the current specification. According to Wixom and Todd (2005), attempts to extend TAM have generally taken one of three approaches: by introducing factors from related models, by introducing additional or alternative belief factors, or by examining antecedents and moderators of perceived usefulness and perceived ease of use. Figure 7 shows summary of some of the most common information system adoption factors reported in the literature.

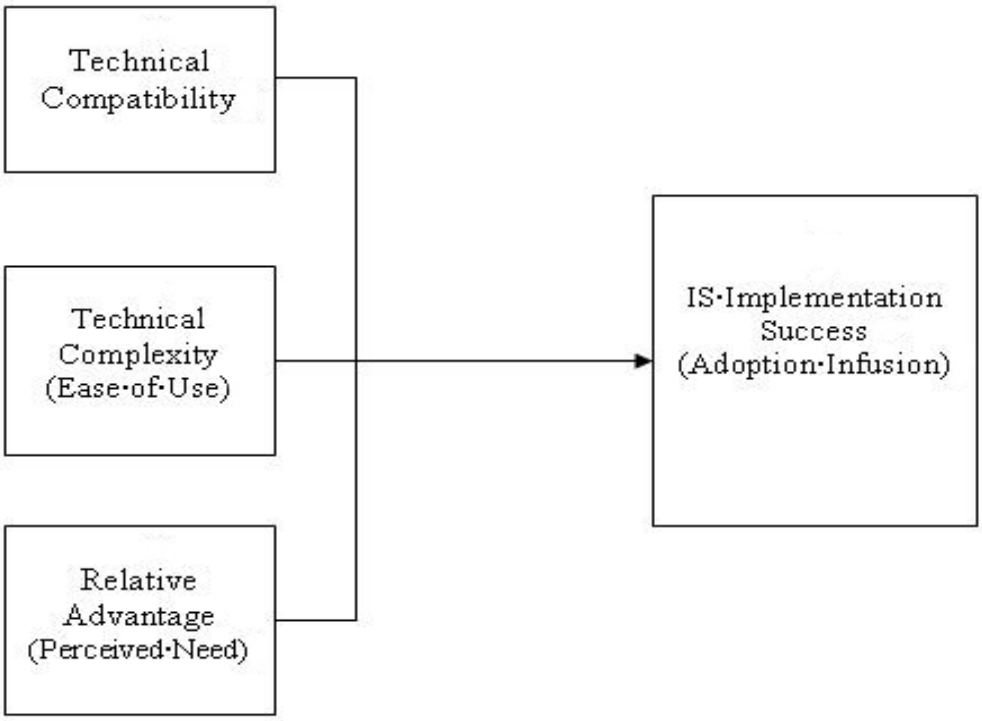

Figure 7. Summary of information system adoption factors (Agarwal & Prasad, 1998; Cooper & Zmud, 1990; Crum et al., 1996).

Summary of DOI Theory

The literature review shows that Roger's (2003) DOI theory has been a viable framework for studying IT and system-related innovation adoption. In comparing some of the suggested attributes by several researchers with Rogers' (2003) attributes, Bryant (2006) identified striking similarities. For instance, relative advantage (Rogers, 2003) is very similar to "compelling value" (Geoghegan, 1994) and "compelling reason to buy" (Moore, 1991, 2002). Compatibility (Rogers, 2003) is an attribute equivalent to "revolutionary change or evolutionary change" (Geoghegan, 1994). Complexity (Rogers, 2003) is very similar to "willing to experiment or wants proven applications"

(Geoghegan, 1994). Trialability (Rogers, 2003) is an attribute equivalent to “willing to experiment” (Geoghegan, 1994), while observability (Rogers, 2003) is very similar to “horizontally connected or vertically connected” (Geoghegan, 1994).

Several IT adoption researchers added Davis’ (1989) perceived usefulness and perceived ease of use of an innovation to Rogers’ (2003) list of factors that explain the rate of adoption of IT related innovations. Brown et al., (2002); and Burgess et al., (2008); for example, proposed mandated system implementation environments to enhance user acceptance where adoption is mandatory as opposed to voluntary. As noted by Wixom and Todd (2005), research on innovation adoption is extending DOI, TAM, and other related models into concepts, constructs, and issues beyond their domains. They are being used to investigate topics related to innovation adoption or usage in today's rapidly changing and complex digital environment.

In the process of investigating and extending models, many suggested that other factors including cost (Khoumbati et al., 2006), support (Themistocleous, 2004), IT infrastructure (Chircu & Kauffman, 2000), and so forth, should be considered in the study of innovation adoption. Agarwal and Prasad (1997) emphasized the significant role of innovation characteristics and perceived voluntariness in the acceptance of information technologies. Tornatzky and Fleischer (1990) argued that the perceived attributes of an innovation proposed by Rogers (2003) are too broad in terms of defining the characteristics of an innovation and identified more than ten attributes (including profitability and social approval) in organizational settings. Table 4 is a summary of factors identified by several researchers that influence the adoption of innovations in different organizations.

Table 4

Commonly Added Attributes as Factors that Affect Adoption of Innovations

Adoption Factors	**Description**
1. Cost	Cost is a significant parameter that influences the adoption of new innovations. Some systems are expensive, complex, and may take several years and cost millions of dollars to get the system up and running (Khoumbati et al., 2006; Wu et al., 2007).
2. Support	For Mabert et al., (2001), top management support, cross-functional teams, and consultants are among the key success factors. The consultants' and vendors' support is an additional factor that influences innovation adoption (Themistocleous & Irani, 2002).
3. Internal Pressures	Internal pressures, such as technical and managerial, affect the adoption process (Chen, 2003; Khoumbati et al., 2006; Kuan & Chau, 2001).
4. External Pressures	A number of researchers, including, Khoumbati et al. (2006), Kuan and Chau (2001), Themistocleous (2004), and Wu (2004) believe that the multiple actors in the current collaborative organizational setting expect improved collaboration and interoperability with all stakeholders. Thus, external pressures should be considered as influential factor to adoption.
5. IT Infrastructure	Appropriate information technologies (IT) legacy systems are considered as an influential factor. Interoperability and integration with the existing IT infrastructure is an important factor that affects technology-related innovation adoption (Bradford & Florin, 2003; Grimson et al., 2000; Themistocleous, 2004).

(*table continues*)

Table 4 (*continued).*

Adoption Factors	Description
6. IT Sophistication	According to Akkermans and Helden (2002) and Themistocleous (2004), IT sophistication is related to the level of technical expertise an organization has. They discussed the contribution of implementation team competence and project champion as critical success factors to the successful adoption of computer-based systems. Moreover, it has been reported that readiness of organization is strongly associated with training and skills development (Mantzana & Themistocleous, 2005).

Perspective of Digital Preservation

The next section of the literature review includes a discussion on digital preservation and provides an overview, current status, and best practices. Many cultural heritage institutions, governments, standards bodies, and research projects around the world are investigating various aspects of digital preservation. This section reviews some of the major institutional, national, and international preservation initiatives that are underway and used as basis for the development of a number of other digital preservation projects including PREMIS. This literature review also provides an overview of issues related to application and implication of metadata in the management and preservation of digital resources.

Digital Preservation in Today's Information Landscape

Cultural heritage institutions are faced with numerous emerging trends and innovations such as the development of open standards and open source software, institutional repositories, geometric growth of blogs and podcasts, peer-to-peer networking, cross-discipline collaborations, and so forth, that impact creation, access, use, and preservation of information resources. Likewise, digital libraries and supporting technologies have now matured to the point where their contents are incorporating complex and dynamic resources and services.

Powered by these technological developments and fuelled by network capability and the digital environment, research is becoming more data intensive in almost every discipline. As Besser (2002) and Chapman (2003) noted, digital libraries will be critical to future scholarship. Not only will they provide access to a host of source materials that researchers need to do their work, but these libraries will also enable new forms of research that were difficult or impossible to undertake before. Researchers can now consult online facsimiles of rare works residing in a host of different institutions without having to visit each one. Researchers who engage in lexical analysis now have the opportunity to count word/phrase occurrences or do syntactical analysis, not just on a single work, but across a whole body of works. As noted by Prom (2003) and Lynch (2003), it is indeed very possible that digital libraries will enable future scholars to engage in new activities not yet envisioned.

Since digital imaging technologies create an entirely new form of information, digital libraries are proliferating onto the information landscape at a dazzling rate. End users now fully expect to have their information needs met digitally wherever and

whenever necessary. To support e-activities (e-scholarship, e-government, e-health, e-market, e-learning, etc.) and improve the accessibility and delivery of digital resources to their respective users, cultural heritage institutions are working on various digital library development activities such as acquiring contents in digital formats and digitizing analog collections.

In the wake of recent large-scale digitization projects aimed at providing universal access to the world's vast textual repositories, cultural heritage institutions are challenged to make such resources accessible, usable, functional, and meaningful for long term use. Building a robust, service-oriented, interoperable digital library is not just a question of scaling existing techniques. It may require a departure from established information systems' protocols and procedures. (Alemneh et al., 2002).

The digital library is similar to a physical library in the sense that it involves similar issues of selection, description, intellectual access, protection and preservation of collections, and provision of user assistance. However, digital objects are very different from physical objects regarding how these needs are satisfied.

In the world of analog materials, preservation management includes an ongoing process of planning and implementing prevention activities. These may include maintaining a stable, safe, and secure environment, ensuring disaster preparedness, and building a basic collection-level maintenance program. Renewal activities include undertaking conservation treatments, replacing the content, or reformatting them on microfilm or digital format. Connaway et al., (2006) considered preservation as the acquisition, organization, and distribution of resources to prevent further deterioration or to renew the usability of selected groups of materials. Preservation management

encompasses all the policies, procedures, and processes that together prevent further deterioration of physical objects, renew the information they contain, and increase their functional value.

With analog materials, preservation and access are separate activities and at times there is a conflict of interest between facilitating access and ensuring long-term preservation. It is possible to fulfill a preservation need of a traditional collection (paper, film, etc.) without solving the collection's access problems. Similarly, access to scholarly materials can be guaranteed for a very long period of time without taking concrete preservation action.

The literature indicates that preservation in the digital world puts to rest any lingering notion that preservation and access are separate activities. A number of authors (Lavoie & Gartner, 2005; Marcum, 2001; Sutton, 1999; among others) contend that the new digital world transforms traditional preservation concepts from protecting the physical integrity of the object to specifying the creation and maintenance of the object whose intellectual integrity is its primary characteristic.

In the last decade, cultural heritage institutions have begun digitizing materials for access and preservation while, at the same time, the long-term accessibility of digitally produced materials is being discussed and debated (Connaway et al., 2006). A growing number of institutions are creating institutional repositories and portals to provide integrated access to their own and other digital resources. In 2004, Google began the book-scanning project with a core group including the New York Public Library and academic libraries at Harvard University, Oxford University, Stanford University, and the University of Michigan. Now, in 2008, there are nearly 30 partners and more leading

cultural heritage institutions are joining the Google Book Scanning Project from all over the world (Pomerantz, 2006).

While the capacity to create digital content is great and the appetite for it seemingly insatiable, much work remains to make the infrastructure robust for creation, description, storage, access, and preservation. The fact that the digital world is evolving at a rapid pace poses new threats and problems as well. Among other issues, cost, technology, copyright complications, and other standards issues are huge impediments to ensuring long-term access. Considering the central role of a digital library in almost all activities, adequately addressing these issues is paramount for the success of the digital library in supporting the demand of the digital/virtual environments (Beagrie, 2006; Connertz, 2003; Tibbo, 2003).

Challenges in Digital Preservations

Digital technologies are shaping creation, management, access, and preservation of information in ways which are so profound that traditional methods are no longer effective (Atkins et al., 2003; Besser, 2002; Day, 2006). Those who have been involved in digital imaging and related projects have learned quickly that digitization technology, in and of it, provides no easy answers for preservation and related issues.

The literature documents issues and challenges that have been raised and discussed among diverse stakeholders. The consensus among these diverse communities is that current digital preservation solutions are inadequate to accommodate the complex set of challenges brought by dynamic, heterogeneous digital resources.

For digital materials, simply maintaining a byte stream does not necessarily ensure the digital material will be preserved at a level acceptable to the cultural heritage

institution and its users. "Access" can be at a variety of levels for digital materials ranging from access to the full range of functionality and content to simple access to the *bare bones* intellectual content of the resources (Hedstrom, 2003).

The mix of IT equipment and media of the digital world increases the need for responsible preservation strategies by institutions. Understanding how to adapt preservation concepts to manage risk in the midst of rapid technological obsolescence to ensure long-term access to digital resources is what preservation in the digital world is all about.

Most digital objects are not only plain text, but also contain special formatting produced by a variety of software in different versions. Paradoxically, in order to ensure long-term access, one must depend on machines that rapidly reach obsolescence to create digital objects and then make them available for use. In this regard, Tennant (1999), Alemneh et al. (2002), and Teper and Kraemer (2002), among others, suspected that magnetic tape might be unreadable just thirty years after manufacture. The newest recording medium, optical disk, may have a longer life than the digital recording surfaces that have come and gone before. It is likely, however, that today's optical storage media may long outlast the life of the computer system that created the information in the first place (Alemneh et al., 2002).

But preservation is only the first step of ensuring that digitally stored information will remain valuable in the future. It also must be accessible over time. Therefore, another step has to be taken that ensures accessibility (Steenbakkers, 2003). Although the cost of preserving complex digital objects over time is not yet known, there is a general agreement (at least, within the cultural heritage community) that preservation is

expensive and will require resource commitments on an ongoing basis. Referring to the cost issue, several commentators (including Hedstrom, 1998; Lavoie & Dempsey, 2006; Lynch, 2003) pointed out that the essence of preservation management is resource allocation. People, money, and materials must be acquired, organized, and put to work to ensure that information sources are given adequate protection. They recommend that metrics are needed to measure the performance of various storage systems over the long-term, assess the effectiveness and costs of different preservation strategies, estimate the value of or benefit from archiving services, and conduct market analysis of user demand. The 2002 Research Libraries Group report on *Trusted Digital Repositories: Attributes and Responsibilities* indicated that different preservation strategies have quite different costs, timeframes, and schedules.

Current Digital Preservation Strategies and Practices

There are now vast amounts of information created in a greater variety of formats than ever before, making it increasingly difficult for cultural heritage institutions to ensure long-term access to their digital resources. A digital preservation strategy is a particular technical approach to the preservation of digital materials that outlines a policy framework applicable to the three main stages in the life cycle of a digital resource: creation, management/preservation, and use (Beagrie, 2006; Lavoie & Gartner, 2005). Digital preservation is as much a strategic problem as a technical one. Considering the complexity of dynamic digital resources, many agree that there are no effective preservation methods or tools that work for all communities or types of resources. As noted by van Wijngaarden (2007), choosing a preservation action depends on so many

factors, including the goal of the action, the characteristics of the digital object, and the significant properties of the file or collection. Figure -8 depicts a summary of the five basic aspects of a digital object that need to be considered in digital preservation action.

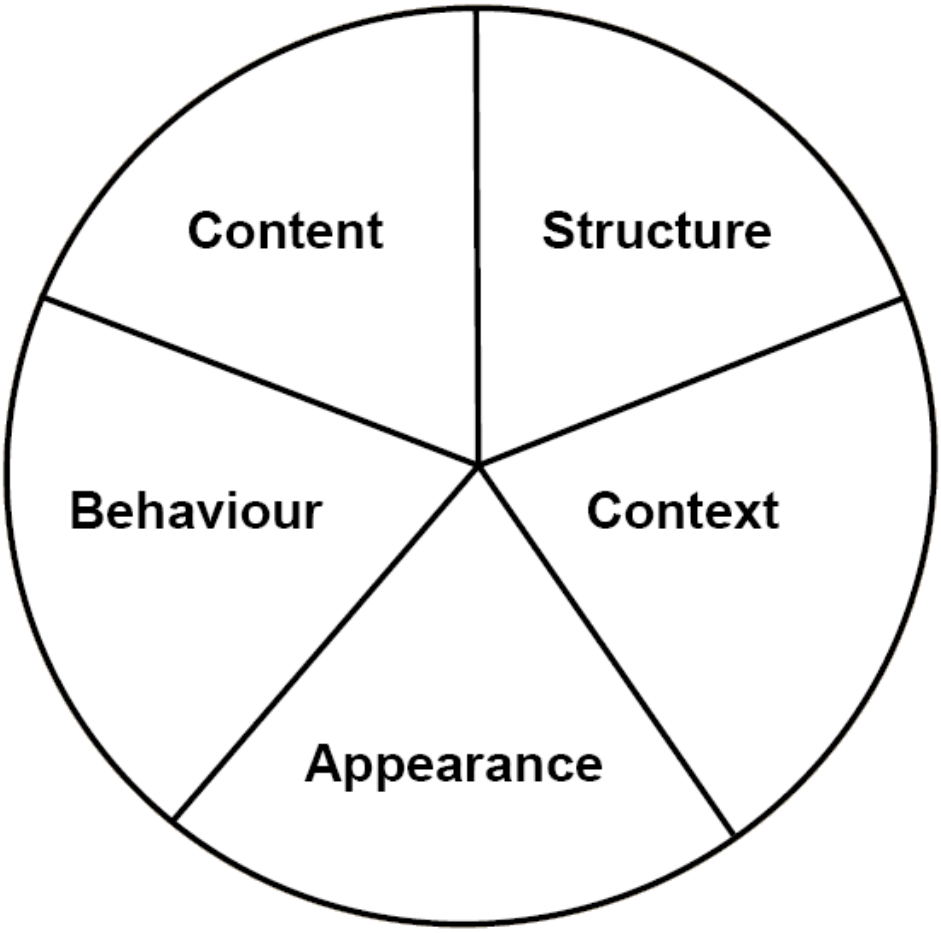

Figure 8. Five basic aspects of a digital object (van Wijngaarden, 2007).

Different projects are addressing different aspects, or combinations of all of these issues, using different approaches. The following section provides brief descriptions of the current digital preservation strategies. In addition, Table 5 provides a summary of the main technical approaches to preserving digital materials.

Technology Preservation

The main technical problems of digital preservation relate to inadequate media longevity, rapid hardware obsolescence, and dependence on particular software products. Hedstrom (2003) concluded that there are no effective methods to preserve dynamic databases, complex Web sites, analytical tools, or software for the long-term. Yet, increasingly, digital resources are impossible to interpret or use without accompanying tools for analysis and presentation. This technology preservation approach proposes that digital data should be preserved on a stable medium. It should be 'refreshed' or copied to new media as necessary and associated with preserved copies of the original application software, the operating system that this would normally run under, and the relevant hardware platform.

Various researchers (Beagrie, 2001, 2003; Hedstrom & Lampe, 2001;) indicated that since digital objects can only be read by software, cultural heritage institutions need to preserve all the software it takes to read the objects to ensure long-term access. Institutions also need to preserve all operating systems that the software runs on, including manuals and specific documentation prepared by the programmers, and all of the hardware on which the operating system runs. If the hardware needs repair, all the necessary hardware parts and trained professionals that can repair the obsolete hardware are also required.

This strategy may have some value for particularly important digital resources. However, as pointed out by several authors on this subject (Beagrie 2006; Chapman, 2003; Giaretta, 2006; Lavoie, 2004) the rapid obsolescence of information technologies suggest that the technology preservation approach cannot be considered as a viable long-

term solution. Of course, the machines cannot be saved if there are no spare parts available, and the software cannot be saved if no one with relevant expertise is available to use it.

Encapsulation

Saving the interpretation together with the original document can prevent inaccessibility and is called encapsulation. According to the National Library of Australia:

> Encapsulation in the context of preserving digital materials is a technique of grouping together a digital object and anything else necessary to provide access to that object. This technique aims to overcome the problems of the technological obsolescence of file formats because the details of how to interpret the digital bits in the object can be part of the encapsulated information. Encapsulation can be achieved by using physical or logical structures called "containers" or "wrappers" to provide a relationship between all information components, such as the digital object and other supporting information such as a persistent identifier, [and] metadata, software specifications for emulation (PADI, 2008).

Encapsulation works very well for simple file structures such as plain text documents written in Unicode format. But for more complex formats which embed dynamic, active or interactive behavior, encapsulation does not make it easier to interpret. To reproduce a representation of the document which is understandable for humans, decryption must be done and specific knowledge and skills are needed to retrieve the information from the document (van der Hoeven, 2004).

Rothenberg (2000) suggested attaching “annotation metadata” to the surface of each encapsulation that would both explain how to decode the obsolete records contained inside the encapsulation and to provide whatever contextual information is desired about these records. Day (1998), Rothenberg (2002), and van der Hoeven et al. (2007) are among strong advocates of the encapsulation method for digital preservation.

Refreshing

Rapid changes in the means of recording information, the formats for storage, and the technologies for use, threaten the life of information in the digital age. Refreshing involves transferring digital materials to a new medium, for instance, changing from CD-ROM to DVD. This strategy is the one that is probably most often employed due to the deterioration of physical media. While this approach addresses the media instability problem, it does not fundamentally address formatting problems (Heminger & Kelley, 2005). As indicated in the Research Library Group (2002) report, refreshing or copying from medium to medium cannot serve as a general solution for preserving digital information.

Emulation

Another approach to digital preservation is technology emulation. This strategy relies (as with technology preservation) on the preservation of the original data in its original format. Instead of preserving the host software and hardware, software engineers build emulator programs that mimic the behavior of obsolete hardware platforms and emulate the relevant operating system. Day (1998) noted that emulation is an important strategy that has potential applications where the look and feel of an original digital resource is important but where it is not worth investing in expensive technology

preservation. Mellor (2003) and Rothenberg (1995) suggested that there may be sufficient demand for entrepreneurs to create and preserve emulators of software and operating systems that would allow the contents of digital information to be carried forward and used in its original format.

A related approach is the digital rosetta stone (DRS) model developed by Steven Robertson of the United States Air Force (Robertson, 1996). Heminger and Kelly, (2005) assesses the DRS model where digital documents would be maintained in their original file formats. They argue that if found to be technologically feasible and economically desirable, the DRS could well lead to a long-term solution for recovering information that would otherwise be impossible to recover.

Migration

Realizing the fact that neither refreshing nor emulation sufficiently describes the full range of options needed for digital preservation, a more general concept of "migration" was introduced. Data migration strategies focus on the need to maintain the digital files in a format that is accessible using current technology and require regular migration from one technical environment to a newer one. As depicted in Figures 9, 10, and 11, migration is the periodic transfer of digital materials from one hardware/software configuration to another or from one generation of computer technology to a subsequent generation (Mellor et al., 2002)

Although no single strategy of the current preservation methods is entirely satisfactory, among various ways of restoring digital formats, migration has worked so far and is recommended by many stakeholders (Research Library Group, 2002).

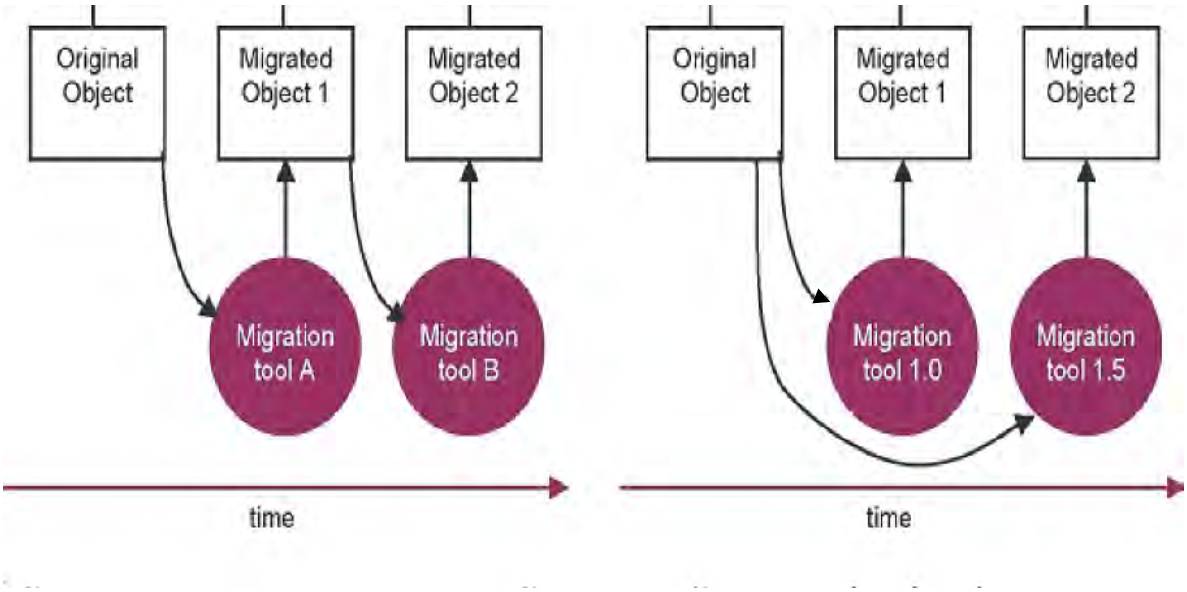

Figure 9. Migration through time (adopted and modified from the CAMiLEON Project; Mellor et al., 2002).

Not only is migration the best known and most widely applied preservation strategy, but it also forms the center of debates and discussions. Advocates say migration is the only serious candidate thus far for digital preservation of large scale archives (Granger, 2002; Mellor et al., 2002), while opponents like Rothenberg (1998, 2002) find migration error-prone, expensive and time-consuming.

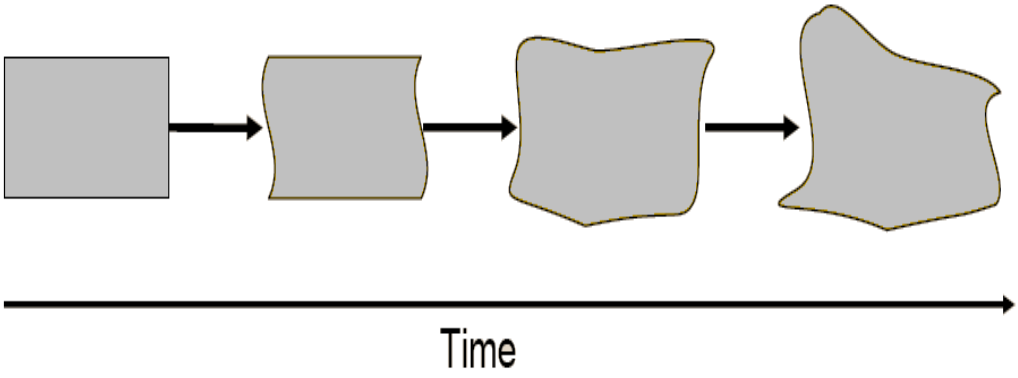

Figure 10. Errors from repeated migration (adopted from the CAMiLEON Project, Mellor et al., 2002).

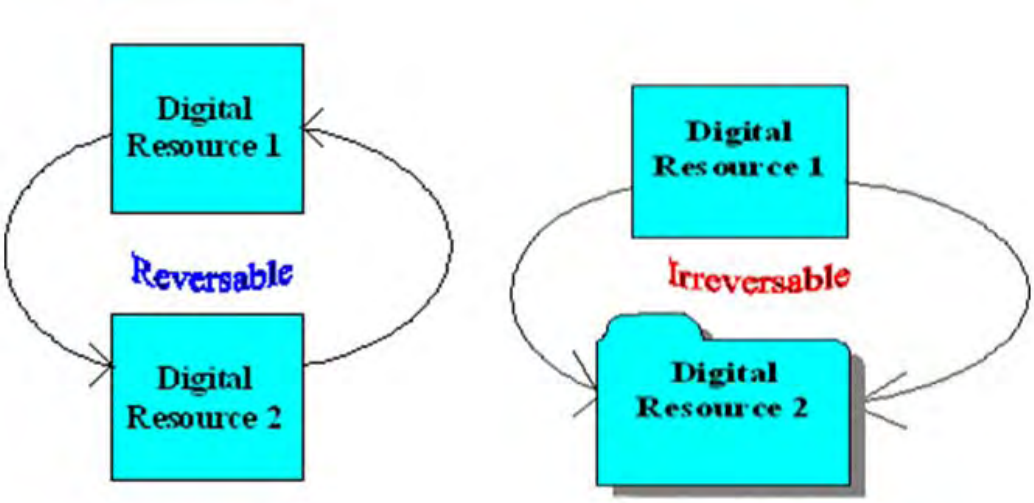

Figure 11. Reversible and irreversible migrations (adopted and modified from the CAMiLEON Project, Mellor et al., 2002)

Table 5 provides a summary and descriptions of the most promising digital preservation strategies that are commonly used by most cultural heritages institutions as they combat the loss of digital information. It also clarifies many possible issues in each approach.

Table 5

Summary of the Current Digital Preservation Approaches

Strategies	Purposes	Involves	Possible issues
Technology Preservation	To view a digitally stored document in its original form	Preserving all the needed hardware devices and software applications	Parts replacement, support and skills will become scarce over time; costly and complex undertaking
Saving the hard copy	To preserve flat data like text and images.	Transforming digitally stored information back to analog form	Loss of look, feel, functionality or even content
Encapsulation	To be able to access the bit stream of a document in all detail at any time	Decryption, interpretation by hand	Interpreting large and complex datasets by hand may be impossible, error-prone, time consuming
Migration	To overcome hardware/software obsolescence, without necessarily retaining "look and feel" or functionality	Content format conversion, recording and saving information about original software environment	Loss of look and feel, functionality, or even content
Emulation	To overcome hardware and software obsolescence whilst retaining aspects of "look and feel" and functionality	Encapsulation of content, original software, specifications, etc; reverse engineering of original software in order to develop emulator specifications or software; development and use of emulation software	Developing new emulator software to allow original software to be run

(*table continues*)

Table 5 (*continued).*

Strategies	Purposes	Involves	Possible issues
Refreshing bits Media migration	To overcome storage media deterioration; to overcome storage media obsolescence	Periodic copying of bit streams from one physical medium to another	The media in the IT industry are constantly evolving and improving, which can make a replacement all but unavoidable within a couple of years
Re-creation	To overcome hardware and software obsolescence	Possibly re-keying of data; reverse engineering of original software in order to develop new software environment; recreating software environment.	Making new version may be equivalent to "re-publishing"
All strategies	-Repeated copying of bit streams is likely to require permission. -Copy-protected media may prevent copying. -Multiple rights owners in content and third party software complicates rights clearance.		

National and International Initiatives

Cultural heritage institutions face challenges to ensure access to digital collections in an environment of exponential growth and volatile technology. Over the last decade, digital preservation has gained growing attention. Different standards, best practices, and various approaches about how to ensure long term access to digital resources are being developed, tested, and openly discussed in the cultural heritage community.

The urgency of the digital preservation issue is openly acknowledged in the 2003 report of the Advisory Committee for Cyberinfrastructure of the National Science Foundation (NSF), which calls for a distributed information and communication technologies system to provide a long-term platform that will support scientific research, and emphasizes the risks of failing to act quickly (Atkins et al., 2003).

A number of collaborative projects have been developed by cultural heritage institutions with funding from charitable trusts and governments, due largely to the recognition of the urgency of the digital preservation issues. Anderson (2008) uses an Ethiopian proverb, "*when spider webs unite, they can tie up a lion*" to describe the importance of such a network of collaborations on a grand scale (p. 5).

The US National Digital Information Infrastructure and Preservation (NDIIP) Program

In 2000, the U.S. Congress provided a special appropriation for development of the National Digital Information Infrastructure and Preservation (NDIIP) program. Congress appropriated $100 million to sustain the enormous digital preservation efforts in a decade-long program. Many cultural heritage institutions throughout the US are investing in comparable initiatives. Since digital preservation raises issues that cannot be addressed fully within the walls of any one institution, the NDIPP fund provided stakeholders with opportunities for partnerships. The Library of Congress is coordinating the activities and seeking more funding to continue technical collaborations that are essential to expanding and strengthening the NDIIPP network over time (Anderson, 2008).

Other Digital Preservation Initiatives

There are a number of other projects in different parts of the world addressing the preservation of digital resources. Digital Preservation Europe (DPE) provides an overview of the current activities of European digital preservation projects, such as Planets (Preservation and Access through Networked Services), CASPAR (Cultural, Artistic and Scientific knowledge for Preservation, Access and Retrieval), LIWA (Living Web Archives), SHAMAN (Sustaining Access through Multivalent Heritage ArchiviNg), DRAMBORA (Digital Repository Audit Method Based on Risk Assessment) to name just a few.

Among other national and regional digital preservation initiatives, these are some of the most promising projects:

- The Digital Curation Center (DCC) of the United Kingdom (UK) was established in early 2004 with funding from the UK Higher Education Funding Council's Joint Information Systems Committee (JISC) and the Engineering and Physical Science Research Council (EPSRC). JISC has already supported a number of preservation programs, including CAMiLEON (a joint effort between JISC and the NSF) and CEDARS (the Consortium of University Research Libraries (CURL) Exemplars in Digital Archives). Like many previous UK-based digital projects, the DCC partnership brings together a unique range of expertise in the field and provides a much-needed focus for the management, use and preservation of research outputs in the UK (Brophy & Frey, 2006).

- The Koninklijke Bibliotheek (KB) is the national library of the Netherlands, which has a long and distinguished leadership position internationally in preservation activity. Among other influential long-term preservation projects, the KB was leading the NEDLIB project. The aim of NEDLIB was to define the basic technological conditions for a networked European deposit library. The NEDLIB was started in 1998 and successfully concluded at the end of 2000. The KB has been a development site for solutions for handling digital publications and established a collaborative arrangement with various international ICT organizations. The KB contracted with the IBM-Netherlands to develop a comprehensive digital preservation solution, called the Deposit of Netherlands Electronic Publications-implementation (DNEP-I; Steenbakkers, 2005).
- The National Library of Australia (NLA) has the Preserving and Accessing Networked Documentary Resources of Australia (PANDORA) project. The purpose of the PANDORA Archive is to collect and provide long-term access to selected online publications and Web sites. To support the acquisition and management of increasing volumes of data, as well as to support more efficient archive building for participants at remote work stations, the NLA developed the PANDORA Digital Archiving System (National Library of Australia, 2008).
- The National Library of New Zealand's (Te Puna M*ā*tauranga o Aotearoa) National Digital Heritage Archive (NDHA), established in July 2004. The goal of the NDHA Program is to ensure that the National Library of New Zealand has the key infrastructural and technological environments it needs to guarantee ongoing

access to and preservation of the Library's digital heritage collections. The project is due to be completed in late 2009 (National Library of New Zealand, 2008).

A Metadata Approach to Digital Preservation

Significant progress has been made in raising awareness about the digital preservation imperative. Based on the various outcomes and recommendations, it seems clear that no one-size-fits-all preservation solution is possible. Different approaches need to be tailored to tackle different threats. t this critical juncture in the evolution of digital preservation there is a growing body of research emphasizing the critical role of metadata as an enabling tool in any successful preservation strategy.

The role of metadata in digital resource management is analyzed, described, and commented upon by many researchers (Alemneh et al., 2002; Besser, 2002; Day, 2001, 2006; Lavoie, 2004, 2008). All agree that the metadata issues will differ according to which particular strategy is adopted. In an emulation approach metadata could be encapsulated together with the application software used to create it as well as a description of the required hardware and software environment. A migration strategy will also depend upon metadata creation to record the migration history of a digital object. In addition, there is a need for contextual information to be recorded and preserved so that a future user can understand the technological environment in which a particular digital object was created.

As mentioned by various metadata promoters, the appropriateness of any metadata model must be measured by balancing the specificity of the knowledge that can

be represented in it and queried from it and the expense of creating the descriptions. Researchers and commentators involved in the preparation of policies and programs to support preservation activities have extended the metadata role. For CEDARS (one of the European preservation projects), the appropriateness of a digital preservation strategy is determined by a digital object's significant properties. A digital object's significant properties are those technical characteristics agreed on by the archive or by the collection manager to be most important for preserving the digital object over time.

A multitude of other digital projects and initiatives believe that the backbone of their preservation function is the creation and maintenance of the detailed metadata associated with the digital object's significant properties. In the next section, some of the most influential and important national and international projects and initiatives are described briefly.

Open Archival Information System (OAIS)

The reference model for an open archival information system (OAIS) is one of the most important metadata models developed by the Consultative Committee for Space Data Systems (CCSDS). OAIS is an International Organization for Standardization (ISO 14721) initiative co-coordinated by the CCSDS that defines a high-level reference model for archives originally concerned with the long-term preservation of digital information obtained from observations of terrestrial and space environments. It describes a specific functional model of both people and system requirements for implementing a digital archive. The recommendations of OAIS may be applicable to other long-term digital archives. The importance of OAIS to the preservation research community is indisputable. Many projects (CEDAR and NEDLIB, among others) are implementing the

OAIS model within the context of the deposit of electronic materials for archiving.

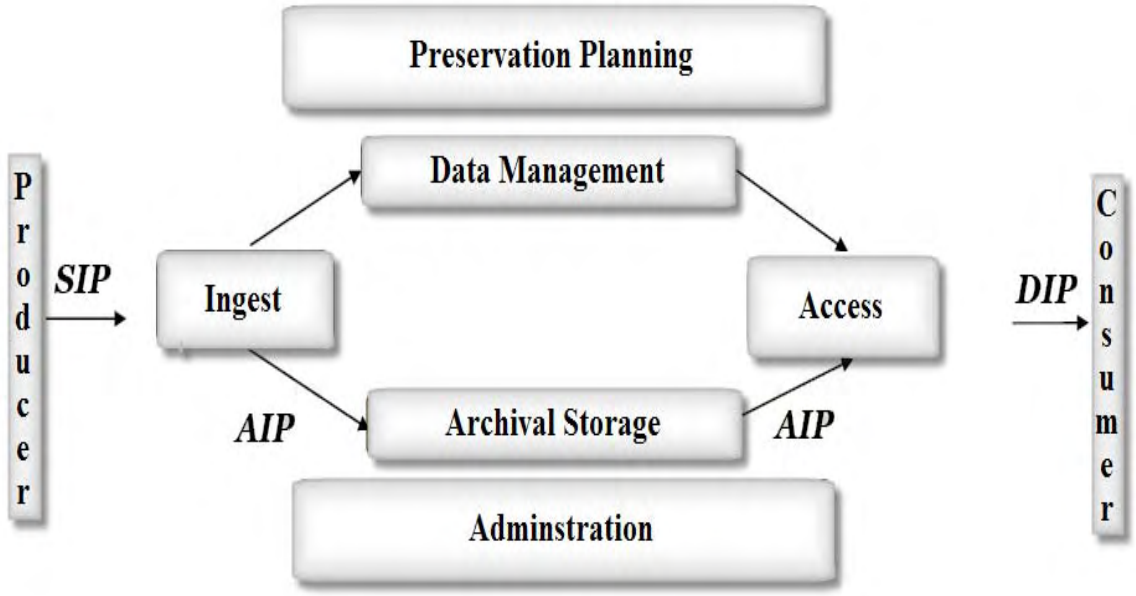

Figure 12. Theoretical model for implementing preservation action (adopted from Functional Model for OAIS; Consultative Committee for Space Data Systems, 2002).

The OAIS model has a "taxonomy of archival information object classes" that includes: content information, preservation description information, packaging information, and descriptive information (Consultative Committee for Space Data Systems, 2002). Table 6 provides a summary description of these object classes. Figure 12 displays the relationship of the OAIS model's functions.

Table 6

OAIS Reference Model Object Classes (Consultative Committee for Space Data Systems, 2002)

Content Information:	This is the information that is the primary object of preservation. This contains the primary Digital Object and Representation Information needed to transform this object into meaningful information.
Preservation Description Information:	This would include any information necessary to adequately preserve the Content Information with which it is associated. It includes: -*Reference information* (e.g., identifiers) -*Context information* (e.g., subject classifications) -*Provenance information* (e.g., copyright) -*Fixity information* (that documents the authentication mechanisms).
Packaging Information:	The information that binds and relates the components of a package into an identifiable entity on a specific media.
Descriptive Information:	The information that allows the creation of *access aids* - to help locate, analyze, retrieve, or order information from an OAIS.

The PREMIS Data Dictionary

Significant progress has been made in raising awareness about the role of metadata in digital preservations and many national and institutional projects have been released various preservation metadata element sets. Building on previous works by various communities, the PREMIS working group developed the Data Dictionary for Preservation Metadata and the first version of the Data Dictionary was issued in May 2005. The PREMIS Data Dictionary is a cross-domain development (libraries, archives, museums, private companies) and a distillation of the best research on preservation metadata. The Data Dictionary contains a set of core Preservation Metadata elements that have broad applicability and its supporting documentation is a comprehensive, practical resource for implementing preservation metadata in digital archiving systems.

The international Editorial Committee is a part of the PREMIS maintenance activity sponsored by the Library of Congress. The maintenance activity also includes PREMIS tutorials and promotional activities, and the PREMIS Implementers Group. The PREMIS Editorial Committee began the revision process in October 2006 and ended with the release of the PREMIS Data Dictionary 2.0 in April 2008. This document is a specification that emphasizes metadata that may be implemented in a wide range of repositories, supported by guidelines for creation, management and use, and oriented toward automated workflows. It is technically neutral in that no assumptions are made about preservation technologies, strategies, syntaxes, or metadata storage and management.

Table 7
PREMIS Data Dictionary Description (PREMIS, 2008)

Semantic unit	Name that is descriptive and unique. Use externally aids interoperability. Need not be used internally in repository.
Semantic components	If a container, lists its sub-elements. Each component has its own entry.
Definition	Meaning of semantic unit
Rationale	Why the unit is needed (if not obvious)
Data constraint	How it should be encoded; *Container*: an umbrella for two or more; no values given *None*: can take any form "Value should be taken from a controlled vocabulary"
Object category	Representation, File, or Bit stream
Applicability	Whether it applies to the category of object
Examples	Illustrative examples of values
Repeatability	Whether it can take multiple values
Obligation	Whether values must be given. *Mandatory*: something the repository must know independent of how or whether the repository records it, means mandatory if applicable, if not explicitly recorded, it must be provided in exchange.
Creation/maintenance notes	Information about how values may be obtained or updated.
Usage notes	Information about intended use.

Table 8

Sample PREMIS Data Dictionary Entry (PREMIS, 2008)

Semantic unit	Size		
Semantic components	None		
Definition	The size in bytes of the file or bitstream stored in the repository.		
Rationale	Size is useful for ensuring the correct numbers of bytes from storage have been retrieved and that an application has enough room to move or process files. It might also be used when billing for storage.		
Data constraint	Integer		
Object category	**Representation**	**File**	**Bitstream**
Applicability	Not applicable	Applicable	Applicable
Examples		2038927	
Repeatability		Not repeatable	Not repeatable
Obligation		Optional	Optional
Maintenance / Creation notes	Automatically obtained by the repository.		
Usage notes	Defining this semantic unit as size in bytes makes it unnecessary to record a unit of measurement. However, for the purpose of data exchange the unit of measurement should be stated or understood by both partners.		

Tables 7 and 8 provide the PREMIS Data Dictionary descriptions. There is an overwhelming consensus among experts (Brophy & Frey, 2006; Day, 2006; and Lavoie, 2008) that PREMIS provides the required standards and best practices for the use of metadata in support of long-term preservation.

The PREMIS Data Model

The PREMIS Data model is composed of five types of entities: “intellectual entities,” “objects,” “events,” “rights,” and “agents”. Figure 13 shows the PREMIS Data Model; in the data model diagram, entities are drawn as boxes while the relationships between them are drawn as lines. However, the PREMIS data model is not a formal entity-relationship model. The data model is for the convenience of aggregation and to provide useful framework for distinguishing applicability of semantic units across different types of entities and different types of objects.

In PREMIS data model, the intellectual entity is considered out of scope because it is well served by descriptive metadata. Intellectual entity refers to a set of content that is considered a single intellectual unit for purposes of management and description (e.g., a book, a photograph, a map, a database). An intellectual entity may include other intellectual entities (e.g. a Website that includes a Web page). Although the intellectual entity is not fully described in PREMIS Data Dictionary, it can be linked to in metadata describing digital representation.

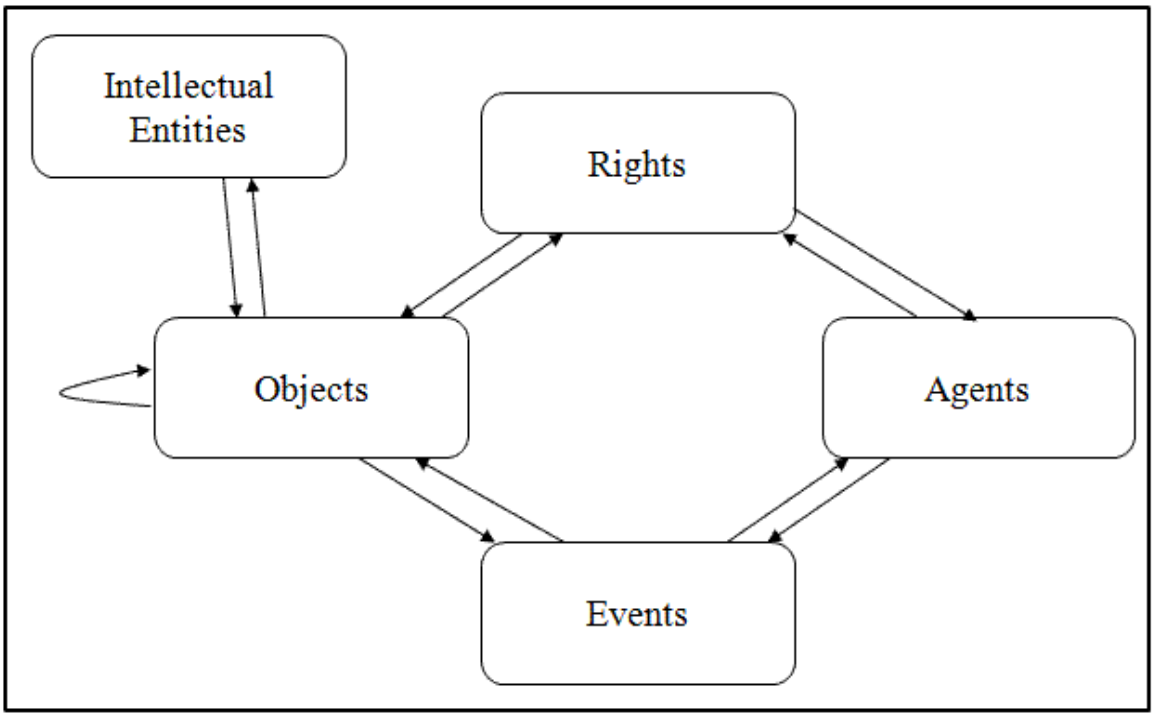

Figure 13. The PREMIS data model –version 2.0 (PREMIS, 2008).

Object refers to a discrete unit of information in digital form. Objects are what a repository actually preserves and as can be seen in Table 7 and 8, there are three types of object categories:

i) Representation (a set of files, including structural metadata that taken together, constitute a complete rendering of an intellectual entity)

ii) File (named and ordered sequence of bytes that is known by an operating system)

iii) Bit stream (data within a file with properties relevant for preservation purposes, but which needs additional structure or reformatting to be stand-alone file)

Events are actions that involve or impact at least one object or agent associated with or known by the preservation repository. The event entity helps in documenting digital provenance by tracking history of an object through the chain of events that occur during the object's lifecycle. The most common events are: migration events (creation of a new version of an object in an up-to-date format), ingest events (transformation of an OAIS SIP into an AIP), and validation events (use of tools such as JHOVE to verify that a file is valid). In PREMIS, determining which events should be recorded, and at what level of granularity is up to the repository.

Rights statements are simply an agreement with a rights holder that grants permission for the repository to undertake an action or actions associated with an object or objects in the repository. Rights statements may not be a full rights expression language. Rather, it focuses exclusively on permissions that take the form, agent X grants permission Y to the repository in regard to object Z.

In PREMIS, agents are not considered core preservation metadata beyond identification and can be a person (Daniel Gelaw Alemneh), organization (University of North Texas), software program (JHOVE version 1.0), or system associated with an event (Portal to Texas History) or a right (permission statement). As can be seen in Figure 13, agents are associated only indirectly to objects through events or rights.

Summary

In this chapter perspectives related to diffusion and adoption of innovations, digital preservation, and preservation metadata were described. There is a general agreement among stakeholders in cultural heritage community that as more scholarly and cultural records exist in digital form, steps must be taken to secure its long-term future. Considering the core issue of digital preservation, more institutions recognize the importance of preservation metadata as a common tool that can facilitate preservation activities.

Investigations of the adoption of other innovations using the framework from diffusion of innovation theory suggest that the adoption process is significantly influenced by many factors including innovation characteristics, adopter perceptions, and various institutional and psychological variables. Preservation metadata is part of digital technology innovation and different communities are adopting PREMIS at different rates. Understanding the nature of adoption in any given situation requires analyzing factors that may facilitate the adoption and those that may operate as barriers to adoption.

In the next chapter, the methodology of this exploratory study is presented.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

Introduction

The purpose of this exploratory study was to examine the factors that affect adoption of PREMIS metadata by cultural heritage institutions using the framework provided by the diffusion of innovations theory. This chapter includes a discussion on the development of the data collection instruments, the collection of data, the methods of data analysis, and the issues regarding reliability and validity. The limitations of the study are discussed at the end of the chapter.

Theoretical Framework

Understanding critical success factors of adoption and implementation of any given information technology system, in any given situation requires identifying and analyzing factors that may facilitate adoption and those that may operate as barriers to adoption.

The theory of diffusion of innovations provides a framework for conceptualizing the adoption of preservation metadata in cultural heritage institutions. Rogers' (2003) five perceived characteristics or attributes were shown to influence the rate of adoption of innovation namely: relative advantage, compatibility, complexity, trialability, and observability.

Table 9

Factors Identified from DOI Literature

	Factors		Others' Descriptions/Modifications
Rogers' Perceived Innovation Characteristics	**1. Relative advantage**		Compelling value/reason, perceived usefulness/benefits (Agarwal & Prasad, 1997; Davis, 1989; Moore, 2002)
	2. Compatibility		Revolutionary/evolutionary change (Beatty, Shim, & Jones, 2001; Geoghegan, 1994)
	3. Complexity		Perceived Ease- of-use (Davis, 1989; Moore, 1991; Taylor & Todd, 1995)
	4. Trialability		Availability for experiments to prove its use, (users want proven applications; Geoghegan, 1994).
	5. Observability		Visibility, result demonstrability, horizontally connected or vertically connected (Geoghegan, 1994; Moore 1991).
Characteristics of Organization Readiness	**6.Readiness of Institution**	Adoption of clusters of related innovations	Relevant knowledge and experience, sophistication of IT infrastructure, IT knowledge and use, the capacity of the institution to adopt successfully, prior conditions (Agarwal & Prasad, 1997, 1998, 2000; Ajzen, 1991; Beatty, Shim & Jones, 2001; LaRose & Hoag, 1996; Sillince et al., 1998; Themistocleous, 2002).
		Recognition of the need	Recognition of the innovation to address the need, perceived organizational support, promotion efforts by senior managements, facilitating conditions (such as Digital Preservation Commitment) (Baker, 1987; Finnie, 1988; Gallivan, 2001)
		Network pressure	Perceived external influence, interpersonal influence, pressure from collaborators/ partners/ competitors/ funders, motivation to comply (Ajzen, 1991; Morales-Arroyo, 2003; Sillince et al., 1998; Taylor & Todd, 1995)

In addition to Rogers' five perceived characteristics, several determinants of adoption related to the institutional readiness would help to gain a better understanding of factors that affect PREMIS adoption in cultural heritage institutions. The literature review revealed that several other attributes have been added to the literature including several key organizational factors that may affect innovation adoption decision. Most researchers (Chen, 2003; Gallivan, 2001; Themistocleous & Irani, 2002) noted that readiness of organization is strongly associated to other parameters such as organization culture, skill sets, and IT infrastructure (architecture, sophistication, skill sets, etc.). Institutional readiness is thus conceptualized as an adoption characteristic, for the purpose of this study.

Table 9 and Figure 14 show all six factors derived from the literature review for the purpose of development of the conceptual model for adoption of PREMIS in cultural heritage institutions.

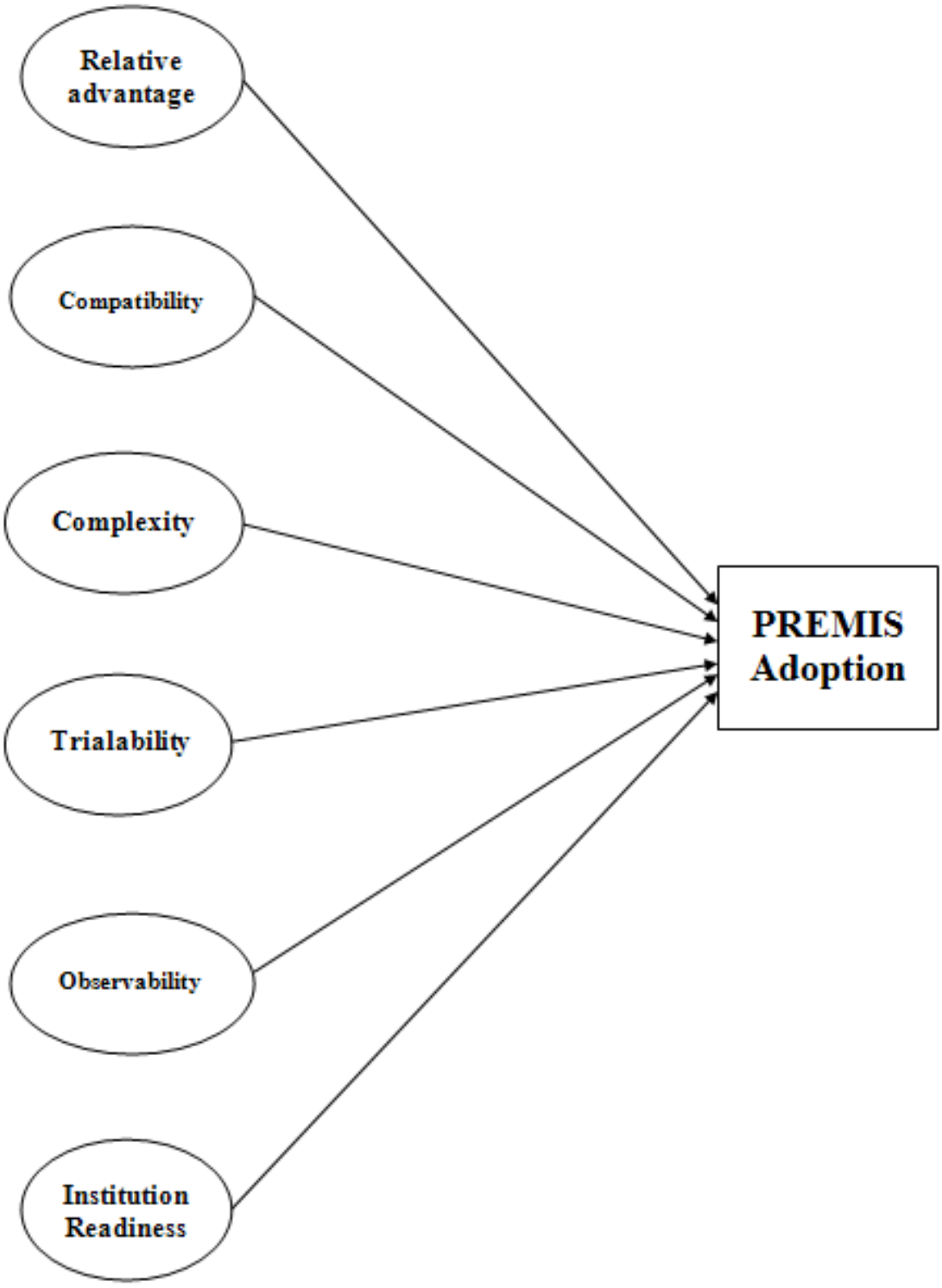

Figure 14. Operationalization of PREMIS adoption factors.

Methodology

This exploratory research study examines the factors that affect adoption of PREMIS in cultural heritage institutions. To gain a broad understanding of factors that affect adoption decision in the context of cultural heritage institutions, the following research questions are addressed:

1. What are the factors (i.e., attributes in the diffusion of innovation theory) that affect the adoption of PREMIS across the diverse cultural heritage institutions?
2. What influence did PREMIS have on their decision to adopt preservation metadata schemes and on current practices of preservation metadata management in the cultural heritage institutions?
3. Among the diverse cultural heritage institutions that adopted or plan to adopt PREMIS, are there commonalities in factors that may affect the decision-making process? Are there differences by type of institution?

These research questions provide the framework for identifying and examining the critical factors influencing stakeholders in the adoption decisions regarding PREMIS in cultural heritage institutions.

This was an exploratory research that used a mixed-method research design. Accordingly, both quantitative (a survey questionnaire) and qualitative (open-ended questions in the questionnaire and a semi-structured telephone interview) methods were employed in an attempt to answer these research questions.

Description of Instruments

The methodology used for this study was a combination of a Web-based survey and follow-up telephone interviews with survey participants who volunteered to participate in the follow-up interviews. These multiple data collection techniques, as mentioned by Church (2001) and Powell (1997) assist the researcher in examining the topic from a range of perspectives and increase the likelihood of collecting valid and reliable data.

This study has received University of North Texas (UNT) Institutional Review Board for the Protection of Human Subjects (IRB) approval. However, the research method and instrument has been modified to better address the specific factors that may affect adoption and the significance of these factors in the cultural heritage institutions perspectives. The modified data collection procedure was submitted to and approved by the UNT-IRB. (See Appendix B).

Survey Questionnaire

A Web-based survey questionnaire was developed and underwent several revisions before being pilot tested on a small subset of the sample. The questionnaire was revised in minor ways following the pilot to eliminate some ambiguous wording. The order of questions was changed and some questions were regrouped. Appendix C includes a copy of the final questionnaire, which was administered online using SurveyMonkey.com.

In alignment with the research method, the survey instrument was developed based on the literature review. The questionnaire focused on the main constructs and factors identified and addressed by past innovation adoption studies between 1980 and 2007. The main objective in this survey was to identify factors that might affect PREMIS adoption as diverse cultural heritage communities relate to their particular institutions or specific type of digital resources.

The questionnaire consists of four main sections. The first section gathered demographic information regarding institutional affiliation, location, position and educational level of the respondents. The second section surveyed the current preservation related activities and institutional context of adoption and application of related technologies, standards, and community practices. The third section of the questionnaire involved several question related to perceptions of the PREMIS, including specific aspects of the PREMIS Data Dictionaries and features, integration of tools, and the role of preservation metadata within the institution's preservation policy framework. The fourth and final section gathered information regarding possible factors influencing PREMIS adoption. The participants were asked to indicate various factors that influence their decisions and weight the importance each factor and the role played in their decision-making processes in light of their respective institutions' specific digital preservation requirements.

In addition, the questionnaire consists of open-ended questions that allowed participants to express their opinions without being limited by the options. The open-ended questions also allowed the respondents to make additional comments. At the end of

the questionnaire, there was a place to provide contact information for those who were willing to be contacted for an interview and to provide more in-depth feedback.

Telephone Interviews

Semi-structured telephone interviews were conducted with individuals who took part in the Web-based survey. Although 21 participants agreed to be contacted for follow-up telephone interviews, 12 survey participants did not participate in the follow-up interviews for various reasons. From the 21 email and/or phone contacts conducted, five of the survey participants who volunteered to be contacted for an interview did not answer at all, three did not have time to participate, one was on maternity leave, one was not working for the institution anymore, and one said that he could not get permission in time (before the scheduled date) from the higher government body to speak on behalf of his country's national library.

Eventually, nine participants took part in the semi-structured interviews. All interviews were conducted by phone. In advance of the interview, participants received a general outline of the interview questions and the UNT-IRB consent form via email, in order to facilitate the interview by giving them the opportunity to refresh their memory before engaging in the interviews. The interview questions were individualized based on their specific survey responses (see Appendix D.) Flexibility rather than standardization is one of the primary characteristics of this method. As May (1993) noted, the open-ended character of this method allows interviewees to talk about the subject in terms of their own frames of reference. In light of this, individual follow-up interviews provided the opportunity for in-depth discussions with the diverse stakeholders who are knowledgeable about issues, problems, and solutions. With a few probing questions, the

researcher attempted to reconstruct the story of the adoption in cultural heritage institutions. Interviews also allowed the researcher to delve into the details of participants' activities and perceptions, which would be of great value for examining the factors that affect the adoption preservation metadata in their respective institutions. As their experiences are first hand and current, the opinions of these interviewees generated a richer understanding of the issues addressed in the survey.

The interviews varied in length with times ranging from 14 minutes to over 25 minutes. The average interview duration was 17 minutes, excluding the time spent explaining the nature of the research and asking for permission to record the telephone conversation. When an interview was about to reach the pre–agreed 15 minutes length of time, 66.67% of the time the interviewees were asked if they wanted to continue or stop the interview. All (100%) of the interviewees decided to continue the telephone interview.

With the exception of one case (in which interview participant did not agree to be audio recorded), all interviews were audio recorded and later transcribed for analysis. For the one not recorded, detailed notes were taken during the interview, and later used for analysis. Some participants also engaged in follow-up email communications to clarify issues further and share or supplement documentations on issues discussed in the interviews.

The mixed-method approach of combining a survey questionnaire with a semi-structured follow-up telephone interview is one of the strengths of this research. In addition to providing data from multiple sources, the mixed-method approach enables the researcher to obtain descriptive accounts of participants from interviews in order to

augment responses to closed-ended questions in the questionnaire. This approach increases the usefulness of individual techniques because they each provide complementary information about the participants and their institutions and enhance the likelihood of collecting valid and reliable data.

For list of frequent concepts used by the interviewees, see Appendix-E. For purposes of analysis, personal names and associated identifiers have been removed in order to protect the confidentiality of the participants.

Population and Sample

The main objective of this study is to identify factors that affect PREMIS adoption in cultural heritage institutions. The population for the survey included all institutions that are participating in the current PREMIS implementers group (PIG) list. Currently, PIG has more than 200 subscribers from all over the world. As described in the PREMIS 2005 report (which summarized the digital preservation activities, based on responses from 49 institutions), the diverse stakeholders in the PREMIS activities include library and information professionals, visual resources professionals, archivists, computer scientists, and anyone engaged in creating, managing, and preserving digital resources.

In order to reach all actual and potential PREMIS adopters, the current PREMIS Implementers Group (PIG) list was used as a main tool to communicate the availability of the survey. Also, for the purpose of this study, efforts have been made to identify stakeholders that represent cultural heritage institutions with high levels of involvement as well as policy and decision making power. Accordingly, the survey link was sent via email to other identified stakeholders, including the nine institutions registered in the PREMIS implementers' institutions registry. Typically, the leaders or chief decision

makers were the initial point of contact and were asked to provide the names of institutional employees who would be key informants in this study, either on the basis of their position in the institution or their role with regard to the adoption of the PREMIS. In addition, the invitation letter requested that they provide the names of other cultural heritage institutions that are considering adopting the PREMIS.

Not surprisingly, many people who received the survey invitation letter forwarded the invitation email and distributed the survey link to a number of local, national, and international discussions lists (with or without the knowledge of the researcher). These include: IFLA, DigiLIB, METS, ASIS&T-DIGLIB (SIG-DL), among other digital libraries-related lists, blogging groups, and Web sites.

Data Collection Procedures and Responses

Invitations to participate in this study were sent in the first week of November 2007. Although a four-week turn-around was requested (from December 04, 2007 to January 06, 2008), which may seem to be a relatively short period for data collection, not 94 (more than 75%) participants responded during the first week. Previous research suggests that an abbreviated period of data collection is one of the advantages of on-line survey research. Smith (1997) states that a large if not a majority of survey responses are submitted within 24-48 hours of exposure.

A reminder email was sent 15 days after the initial mailing. Considering that the timing was during the holiday season, the deadline was extended by another two weeks. A second follow-up email was also sent to potential participants to let them know about

the two week extension and remind them to complete the survey questionnaire. Although responses could be made either by individual professionals or project teams as a group, all responses were made by individuals from the diverse cultural heritage institutions. At the time of closing the survey, a total of 126 responses from 20 different countries had been received. After removing some duplicate and empty responses, we were left with 123 data.

Table 10 shows the composition of survey participants based on respondents' institution categories. The large majority of respondents were from higher education institutions followed by archives, museums, and national libraries in that order. Despite the 123 survey participants, only 56 (about 45%) of the respondents provided complete data. Out of which 21 (37.5 %) agreed to participate in the follow-up telephone interviews. This is still a good response rate for this type of survey especially given the length and depth of the survey, which allowed the documentation of current practices and capture of factors that affect PREMIS adoption across cultural heritage institutions. The survey demographics are presented in detail in chapter 4.

Although the target population of the study included all registered subscribers of PREMIS list and although the survey invitation letter specifically invited institution that had implemented (or planned to implement) PREMIS, some of the respondents had only heard of PREMIS but had not really explored it enough. While such respondents could still be considered usable respondents in the data analysis, the representativeness of such data is questionable. To avoid this issue, during the research design phase, a number of supplementary works were considered.

To check the respondents' level of understanding of PREMIS, this study added a number of questions: "rate the following parts of the PREMIS entities in terms of importance for your institution's preservation requirements: (1) Object entity, (2) Event entity, (3) Agent entity, 4) Right entity" to the questionnaire. Moreover, the question that required respondents to indicate their adoption stage was the key question to categorize institution's adoption level: "How do you characterize the state of PREMIS adoption at your institution?"

Table10

Distribution of Respondents by Institution Type

Institution Type	All Survey Participants	Percent %		Participants Provided Complete answers	Percent %
Higher Education Institutions	48	39.0		23	41.1
Archives	20	16.3		11	19.6
National Libraries	10	8.1		10	17.9
Museums	18	14.6		4	7.1
All Others	27	22.0		8	14.3
Total	123	100		56	100.0

Table 10 shows that out of 123 respondents, 67 (about 55%) respondents had one or more unanswered questions. As shown in the third column of the table, 56 (about 45%) respondents provided complete data including their institution PREMIS adoption stage that used for most of the data analysis. However, irrespective of their completeness, all of the 123 responses were included in the dataset for analysis. Considering the population list of this study, research participants are active members of the PREMISE discussion list who possibly have special interest and knowledge that can fit the purpose of the study. The statistical analysis program (SPSS) uses only items that have valid responses when computing the statistics in each analysis. But, a missing item in one analysis might be a valid response in another analysis. In order to reduce the risk of any potential respondent bias and avoid any loss of information, all of the 123 responses (whether or not they answered all the survey questions) were included in the dataset for analysis.

The selection of a sample for interviews from the survey participants depended on the willingness of the subject; however twenty-one survey participants volunteered to participate in the follow-up telephone interviews. Some respondents left written input that included some personal opinions about the survey. These comments included personal information, such as the respondents' attitude towards specific aspects of PREMIS, their role in their institution, their contact emails addresses and/or telephone numbers as well as some valuable input about digital preservation activities in their specific environments. After removing any personal information from the statements, the qualitative statements were integrated with the interview data and used throughout this study to highlight the general findings. The items are listed in Appendix E. This good overall response reveals a

good level of interest in and engagement with the topic in cultural heritage institutions. Perhaps, the magnitude of the digital preservation problem and the potential role of PREMIS encouraged most respondents to participate. Chapter 5 offers further speculation.

Data Analysis

For analysis purposes, the survey data was divided into sections. From the survey, for example, a profile of the stakeholders was obtained and a description of demographic data provided. Descriptive data organized and presented using an appropriate method. Descriptive statistics such as percentages, means, and so forth were used to summarize and analyze quantitative data.

The qualitative data was summarized and qualitatively analyzed using content analysis techniques. The semi-structured telephone interviews were transcribed and qualitatively analyzed. For example, inter-coder agreement was used as a measure of reliability, and descriptive data analysis tools. The interview answers are used in chapter 4 to give context and the results are interpreted within the context of respondents being self-selected rather than selected randomly. The participants interviewed came from nine different institutions, and it was possible to make some triangulations in those nine cultural heritage institutions.

In order to partially answer the first research question, regression analysis was conducted. The regression analysis used "Adoption of PREMIS" as the dependent and six of the factors identified from the diffusion of innovations model, (namely relative

advantage, compatibility, complexity, trialability, observability, and institutional-readiness) as independent variables that are predictors of adoption.

These methods in combination were used to collect relevant data that provided great insight of factors and possible relationships that tell the story of adoption of preservation metadata in the cultural heritage community.

Validity and Reliability

To ensure validity, reliability, and relevance the questionnaire was designed based on reviewing prior, related researches. Both innovation adoption research and information systems research give insights in the dimensions that were chosen to characterize preservation metadata adoption.

As discussed in chapter 2 and summarized in Table 9, variables and characteristics of innovations that may influence its adoption and questions/items in the instruments of the study were carefully constructed after thorough review of the relevant literature on adoption of innovations, including, but not limited to, Rogers' (2003) diffusion of innovations theory.

Table 11

List of Questions by Construct

Factors		Survey Questions	Abbr.
Perceived Innovation Characteristics	**1 Relative Advantage**	13-C. In my opinion, implementing the PREMIS represents a desirable decision for our institution. 13-D. PREMIS enables us to better diagnose preservation issues. 13-G. PREMIS provides more opportunities for preservation. 13-N. Adopting PREMIS is resulting in overall improvements of digital preservation activities at my institution.	13-C 13-D 13-G 13-N
	2 Compatibility	13-E. By integrating PREMIS, my institution is helping other members to acquire the basic metadata skills. 13-L. The PREMIS is compatible with the long term access policy and procedure in our institution. 13-O. There is room to make some local adaptations in how the PREMIS is implemented without jeopardizing its effectiveness.	13-E 13-L 13-O
	3 Complexity	13-I. Taking risks on new systems and standards that might enhance digital preservation management are worth the resource invested in them. 13-S. Technical assistance is available to our institution as we proceed with the implementation process. 13-V. My institution would be likely to adopt PREMIS, only as long as it requires natural and incremental changes to the existing system.	13-I 13-S 13-V

(table continues)

Table 11 *(continued).*

Factors		Survey Questions	Abbr.
Perceived Innovation Characteristics	**4 Trialability**	13-F. My colleagues and I enjoy figuring out how to use PREMIS effectively for a variety of resource management situations in our institution.	13-F
		13-H. My institution was one of the first institutions to experiment with PREMIS.	13-H
		13-K. There has been healthy discussion about adopting the PREMIS within this institution.	13-K
	5 Observability	13-B. Cultural heritage institutions are enthusiastic about the PREMIS.	13-B
		13-M. Adopting PREMIS is improving the image of my institution.	13-M
		13-P. There is limited research literature that shows PREMIS role and significant improvements in digital preservation as a result of PREMIS adoption	13-P
		13-U. The experience of other organizations adopting the PREMIS convinces me of its effectiveness.	13-U
Readiness of Institution	**6. Institutional-Readiness**	13-J. My institution has the resources necessary to support the ongoing adoption of the PREMIS.	13-J
		13-Q. My institution is well informed about the PREMIS	13-Q
		13-R. My institution has the know-how to adopt the PREMIS.	13-R
		13-T. Employees involved in the implementation of the PREMIS know their efforts are appreciated by the institution.	13-T

The questionnaire included items measured using a five-point Likert-type scale, with anchors ranging from *strongly agree* to *strongly disagree.* Table 11 shows variables with their corresponding items in the questionnaire. The items were worded with proper negation and randomly sequenced to ensure the balance and reduce monotony of questions measuring the same construct. In addition, the questionnaire went through a three-round revision process and was modified based on the recommendations of three groups of people. First a focus group of five, including the researcher's dissertation committee members, evaluated the questionnaire to see if the relevant items were included. Second, it was further reviewed by a panel of four professionals, who are colleagues of the researcher. Finally, small samples of participants were asked to complete the questionnaire to pilot it.

Responses to open-ended questions in the survey questionnaire as well as transcripts from the telephone interviews were summarized using content analysis. It is widely acknowledged that inter-coder reliability is a critical component of content analysis. Neuendorf (2002) noted that since the goal of content analysis is to identify and record relatively objective characteristics of messages, reliability is paramount.

Assumption

The sample responses were self-selected and there may be a self-selecting bias that is inherent in any survey that is answered voluntarily. There may also be a possible bias towards the more motivated stakeholders, early adopters, and innovators.

The PREMIS is the widely accepted and comprehensive specification for preservation metadata. Since the PREMIS Data Dictionary for preservation metadata was produced from an international, cross-domain consensus-building process, there is no major difference among international cultural heritage institutions.

Limitations

The technological innovation literature has identified many variables that are possible determinants of organizational adoption of an innovation. This large number of variables suggests that more research is needed to identify the critical ones (Thong & Yap, 1996). For instance, when the adoption and diffusion process takes place between one country and another, between one community and another [example between museums and libraries (Morales Arroyo, 2003)], as well as between different departments within the same organization (Kautz & Heje, 1996). However, there are still many issues regarding the practical adoption of the preservation metadata, and not often are the results expected by the application of preservation metadata achieved.

Interviewers may ask leading questions that suggest a preferred answer, or on the other hand ask so broad a question as to generate no meaningful answer. In this regard, the researcher has worked in digital preservation and metadata management related areas. As a result, the researcher has developed specific biases and attitudes towards PREMIS adoption. To address the issue of personal bias, a well-formulated set of questionnaire and interview questions were designed. In addition, the questions were extensively field-tested by colleagues.

Since the data collection was conducted in early 2008, just before the release of the new version of the PREMIS, the timing of the data collection can also be mentioned as a limitation. Even though the researcher attempted to contact some of the early adopters (after the release of PREMIS 2.0), it was still too early to know the effects of the changes.

There is a lack of research on the issue of preservation metadata adoption. This research on this subject just barely begins to show the many layers of this complex problem and thus much remains to be illuminated. Considering the diverse needs of cultural heritage institutions and the multi-faceted issue of digital preservation, the results of this study may not be generalizable to the entire universe of metadata adoption in the so many diverse cultural heritage communities.

Summary

This research used survey questionnaires and telephone interviews to collect both quantitative and qualitative data. Semi-structured, follow-up telephone interviews were conducted with the survey respondents who were willing to participate in the interview to clarify and confirm the questionnaire data. By consulting and involving actual stakeholders (who are active in developing improved solutions for digital preservation challenges), factors that affect adoption of preservation metadata identified and discussed. In addition to administering and analyzing the data from the questionnaire and interview, the researcher conducted a comprehensive review of the available innovation adoption literature to develop criteria. The constructs utilized to understand factors

affecting PREMIS adoption in cultural heritage institutions were relative advantage, compatibility, complexity, trialability, and institution readiness. Descriptive statistics methods were used to summarize the data and to identify similarities, differences, and possible relationships among factors and institutions.

Such triangulations of methods provided a holistic framework to identify factors and their relationship in order to understand the factors that affect adoption of preservation metadata in cultural heritage institutions. This approach also helped the researcher in examining the topic from a range of perspectives and increased the possibility of collecting/analyzing valid and reliable data.

The content rich data are compiled, analyzed and findings are discussed in the next chapter.

CHAPTER 4

FINDINGS AND ANALYSIS

Introduction

This chapter analyzes the collected data and discusses it in light of the three research questions. The first section provides a general overview of the demographics, which covers the characteristics of respondents and other variables considered in the survey. The descriptive analysis section covers the findings for the six factors and categorizes subjects by different characteristics including types of institutions and adopter categories/stages. The organization of the findings and results help to depict how the data addresses each research question explicitly. Finally, findings for the three research questions are discussed and summarized in the last section.

Demographic Characteristics of Participants

This section provides a general overview of the main demographic variables considered in the survey. The population for this study consisted of all institutions that are participating in the current PREMIS Implementers Group (PIG) list which has more than 200 subscribers from around the world. Although the original target population included all employees of institutions on the list involved in relevant activities, not every institution was represented in the final data set (completed questionnaires and interviews). Hence, a conscious decision was made by the researcher to use individual

employees (rather than institutions) as the unit of data analysis because the level of measurement in this study was the individual participant.

The final sample consisted of 123 respondents and there was a broad geographic spread representing a range of cultural heritage institutions from 20 different countries. The regional distribution of respondents is shown in Figure 15 and Table 12. The three countries with the large majority of respondents were the USA with 47 (38.2%), followed by Canada with 25 (20.3%), and the UK which had 15 (12.2%). These three countries accounted for about 70% of the overall participating institutions.

Table 12
Distributions of Survey Participants by Country

No.	**Country**	**Frequency**
1	US	47
2	Canada	25
3	UK	15
4	Other countries	36
	Total	**123**

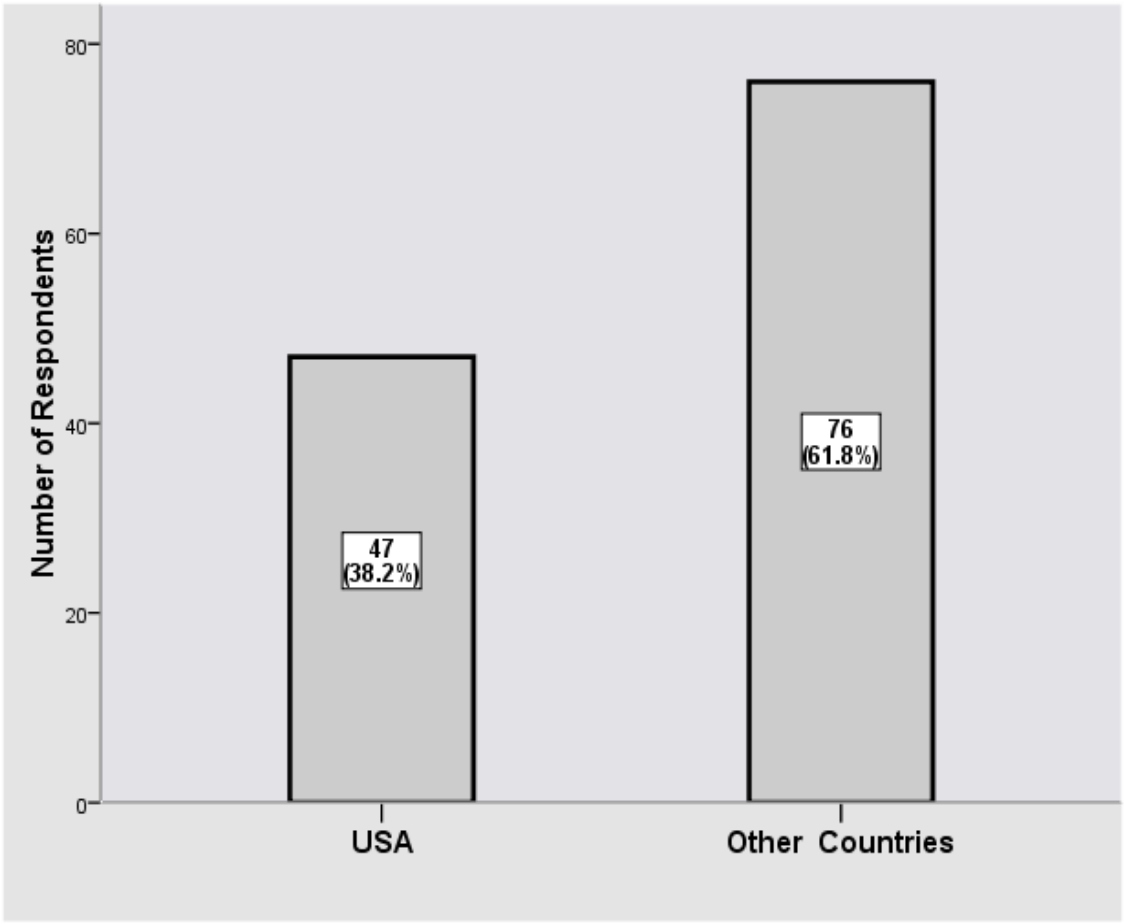

Figure 15. Regional distribution of survey participants.

The distribution of responses in this survey does appear to over-represent North America and Europe. It is possible that this was due to the survey being conducted in English. Although the survey was conducted in English, the invitation letter was also translated to the Spanish language and distributed to Spanish-speaking countries (see Appendix-C).

The survey questionnaire collected several demographic characteristics of the research participants such as their institution affiliations, locations, positions, and levels of education. Regarding educational background, Table 13 shows that almost two-thirds (67%) of the respondents have graduate-level degrees (about 11% Doctoral and 56% Master's degrees).

Table 13

Distribution of Survey Participants by Educational Level

		Frequency	Percent (%)	Valid Percent (%)	Cumulative Percent (%)
Valid	Doctoral Degree	14	11.4	11.7	11.7
	Master's Degree	67	54.5	55.8	67.5
	Bachelor's Degree	27	22.0	22.5	90.0
	Some College	6	4.9	5.0	95.0
	Other	6	4.9	5.0	100.0
	Total	120	97.6	100.0	
Missing	System	3	2.4		
Total		123	100.0		

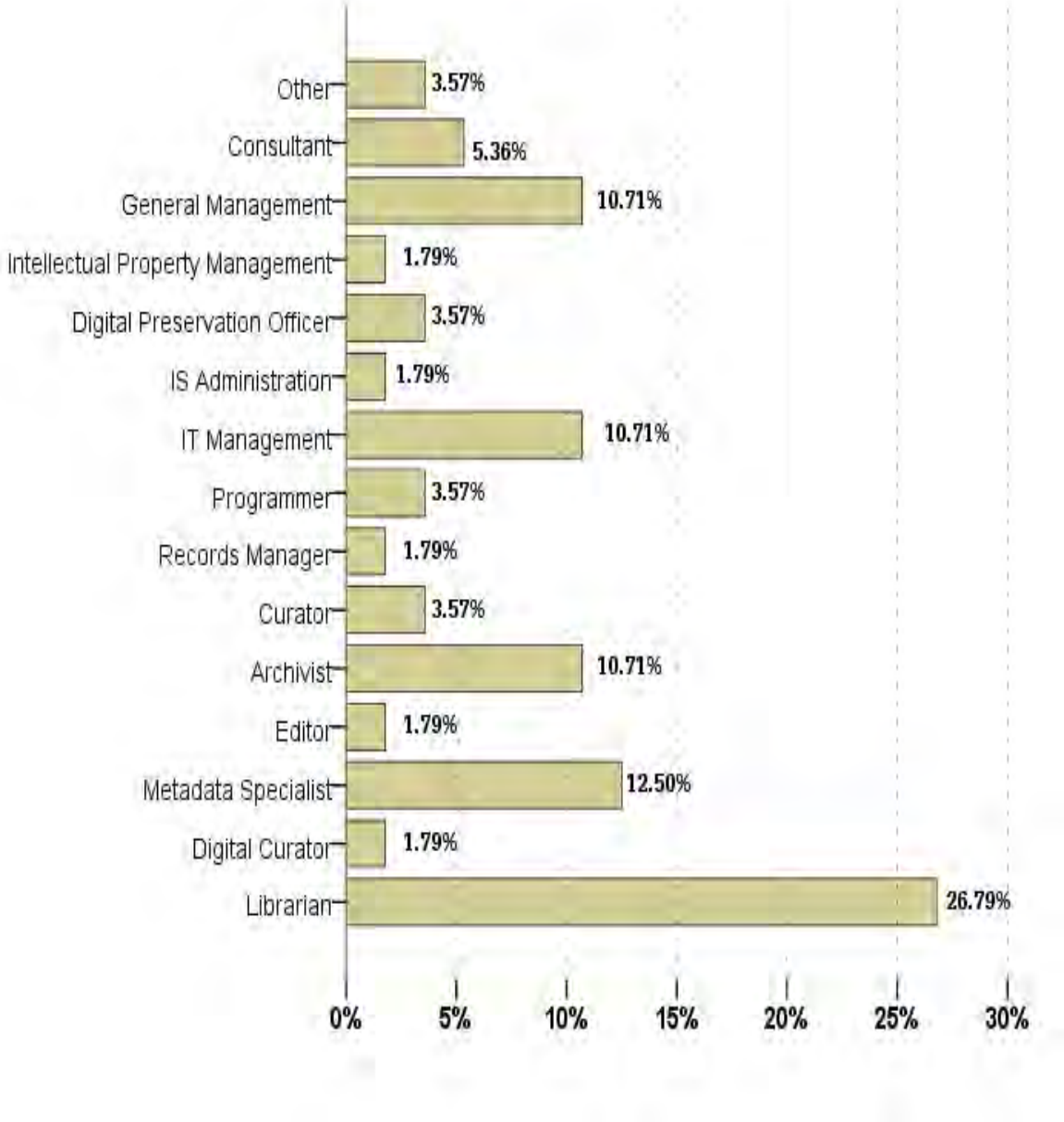

Figure 16. Distribution of the participants by fields of specialty.

Respondents' fields of specialty were distributed as shown in Figure 16; a significant number (about one-fourth or 26%) of the respondents were librarians, while more than 20 % represented IT and general management positions. However, it is interesting to note that many respondents to the survey indicated that they regarded themselves as metadata specialists, archivists, digital curators, intellectual property

managers, and digital preservation officers. As noted by Lee, Tibbo, and Schaefer (2007), in the past a data creator may have had little or nothing to do with subsequent curation, but today the digital environment demands that understanding bridge the differing roles.

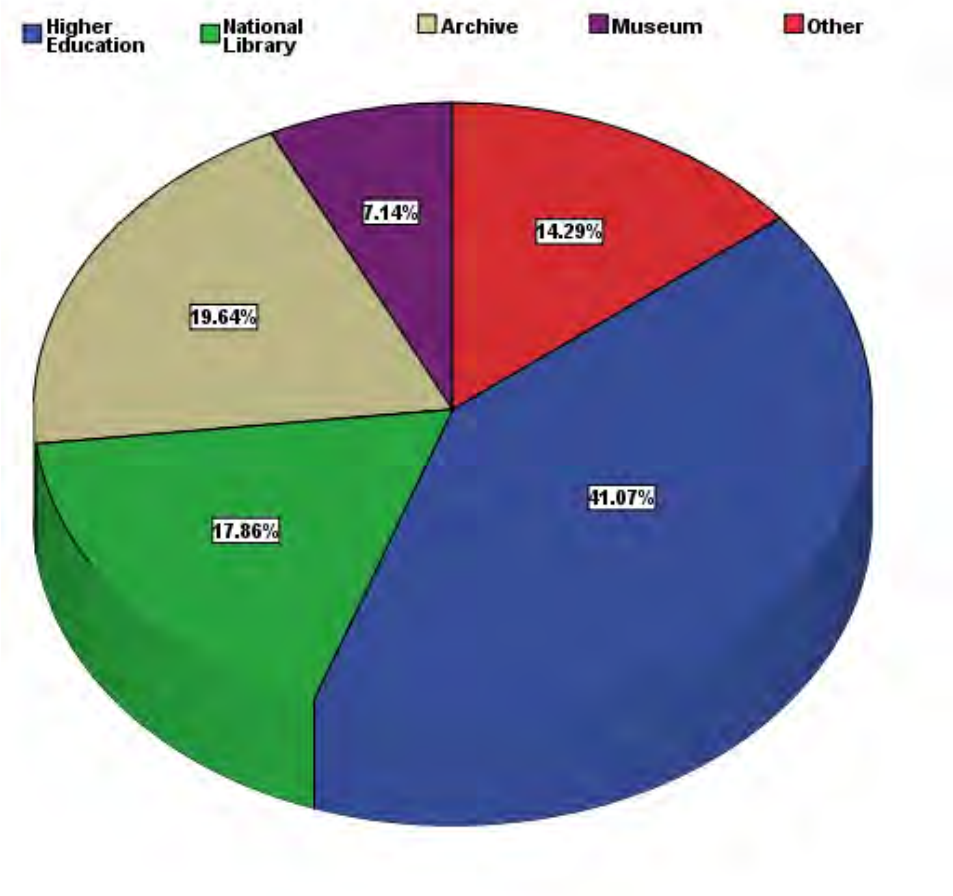

Figure 17. Survey respondents by institution type.

As can be seen from Figure 17, respondents were predominantly from higher education institutions (about 40%), followed by archives (about 18%), museums (16%), and national libraries (9%). Some of the participant institutions categorized as *others* include: government and non-government research institutes, digital documents producers (e.g., publishers, broadcasting agencies, or image service companies), non-profit art institutions, and other libraries (e.g., public, state, and charity libraries).

Table 14

PREMIS Adoption Stage by All Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Fully Adopted	4	3.3	7.1	7.1
	Development (alpha beta) Stage	17	13.8	30.4	37.5
	Planning Stage	22	17.9	39.3	76.8
	Considering/ Investigative Stage	7	5.7	12.5	89.3
	Not Yet Considered	6	4.9	10.7	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
Total		123	100.0		

Adoption Level Category Assignment by Subject Self-Identification

The respondents filled out a survey question that indicates their institution's level of PREMIS adoption: "Question 12: How do you characterize the state of PREMIS adoption at your institution?" As shown in Tables 14 and 15, 56 respondents provided data regarding their institution PREMIS adoption stage.

Table 15

Adoption Stage by Institutions Cross-Tabulation

Adoption Level		Institutions					
		Higher Education Institutions	Archives	National Libraries	Museums	Others	Total
Fully Adopted	Count	2	1	0	0	1	4
	% of Total	3.6%	1.8%	.0%	.0%	1.8%	7.1%
Development (alpha-beta) Stage	Count	9	2	6	0	0	17
	% of Total	16.1%	3.6%	10.7%	.0%	.0%	30.4%
Planning Stage	Count	9	5	3	1	4	22
	% of Total	16.1%	8.9%	5.4%	1.8%	7.1%	39.3%
Considering/ Investigative Stage	Count	2	1	1	1	2	7
	% of Total	3.6%	1.8%	1.8%	1.8%	3.6%	12.5%
Not Yet Considered	Count	1	2	0	2	1	6
	% of Total	1.8%	3.6%	.0%	3.6%	1.8%	10.7%
Total	Count	23	11	10	4	8	56
	% of Total	41.1%	19.6%	17.9%	7.1%	14.3%	100.0%

Table 15 shows the results of adoption stages and institutions' cross-tabulations. Figure 18 also shows the PREMIS adoption stage category as assigned by the respondents. It is interesting to note that the institutions' adoption stage assignments by the respondents tend to show a normal distribution, which resembles Rogers' (2003) adopter categories, namely: innovators, early adopters, early majority, late majority and laggards. In chapter 5, the researcher speculates further on this topic and provides more analysis and synthesis in light of the diffusion of innovations theory.

In responding to Question 12, some respondents may have experienced some difficulties with their category assignments. A number of respondents were unsure where their institutions were, in terms of PREMIS adoption, despite being active within their institution's preservation metadata implementation groups. In this regard one of the respondents said that it was a challenge to assign his institution to the fully adopted stage. This is partly due to the fact that PREMIS conformance was not clearly understood by some adopters. As noted by Woodyard-Robinson (2007), conformance to the PREMIS Data Dictionary is difficult to measure and open to interpretation.

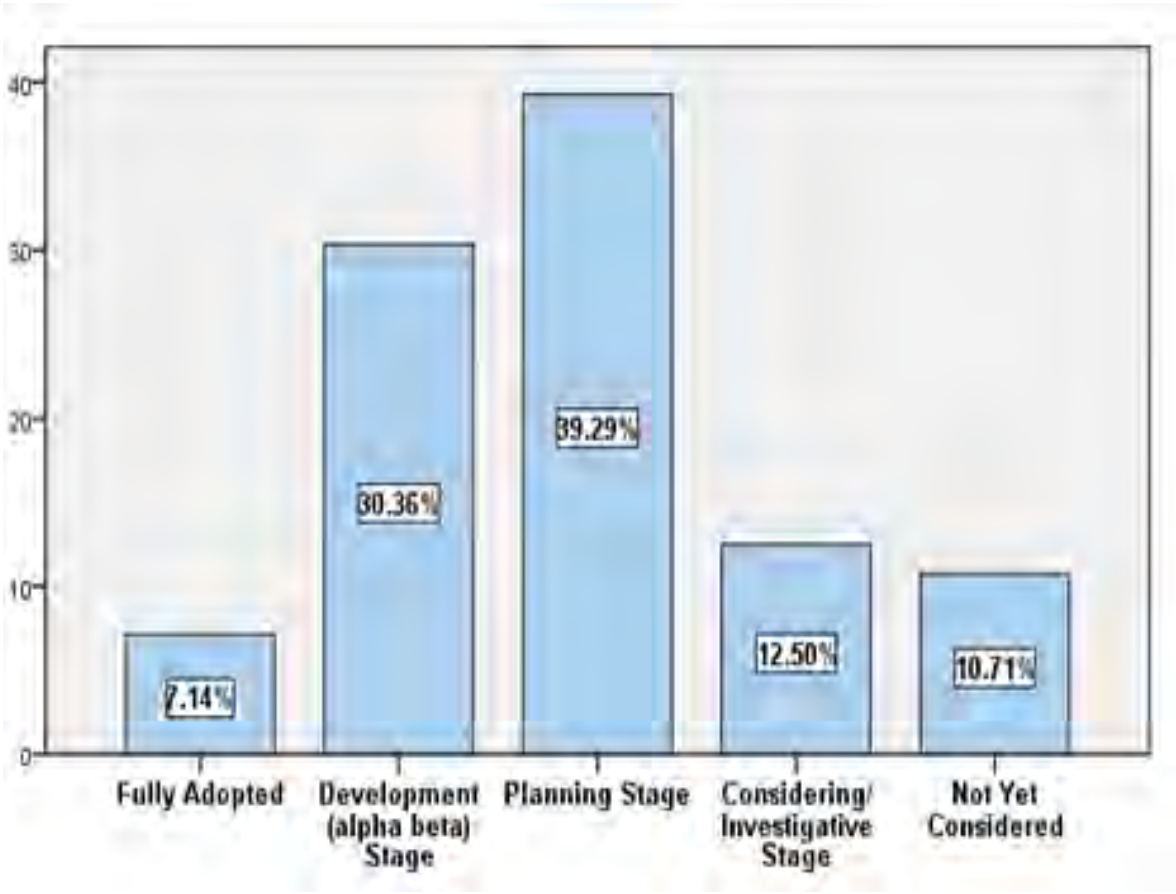

Figure 18. Respondents organized by PREMIS adoption stages.

Although the discussions in this section were not part of a research question, the findings are interesting and, of course, the procedures were useful to support the three research questions. Other sources were used to verify the adoption stages categories assigned by the respondents. In this regard, each institution's adoption stage category assigned by the participants were compared with some of the characteristics of adopters of an innovation (see Appendix-C, Question 16 of the survey), which were derived from the literature regarding the diffusions of innovations theory.

In addition, subjective analysis of the interview data and the PREMIS Implementers' discussion lists were used as sources to identify institutions' each institution's level of commitment to adopting digital preservation metadata. Accordingly, for analysis purposes, the data were reorganized into two broad categories of adoption stage:

1. Decision has been made to adopt PREMIS
2. Decision has not been made to adopt PREMIS

Table 16

Adoption Decision Status by Institutions Cross-Tabulation

		Institutions					
		Higher Education Institutions	Archives	National Libraries	Museums	Other Institutions	Total
Decision has been made to adopt	Count	20	8	9	1	5	43
	%	46.5%	18.6%	20.9%	2.3%	11.6%	100.0%
Decision has not been made to adopt	Count	3	3	1	3	3	13
	%	23.1%	23.1%	7.7%	23.1%	23.1%	100.0%
Total	Count	23	11	10	4	8	56
	%	41.1%	19.6%	17.9%	7.1%	14.3%	100.0%

As can be seen in Table 16, institutions were assigned to one of the two categories: *Decision has been made to adopt* or *Decision has not been made to adopt.* This categorization was based on respondents' self-assignment. As Figure 19 shows, the fact that an institution was at the *planning stage*, *development stage*, or *fully adopted stage* indicates that a decision had already been made to adopt PREMIS, whereas if the institution had *not yet considered* or was still at an *investigation stage*, the decision had not yet been made to adopt PREMIS.

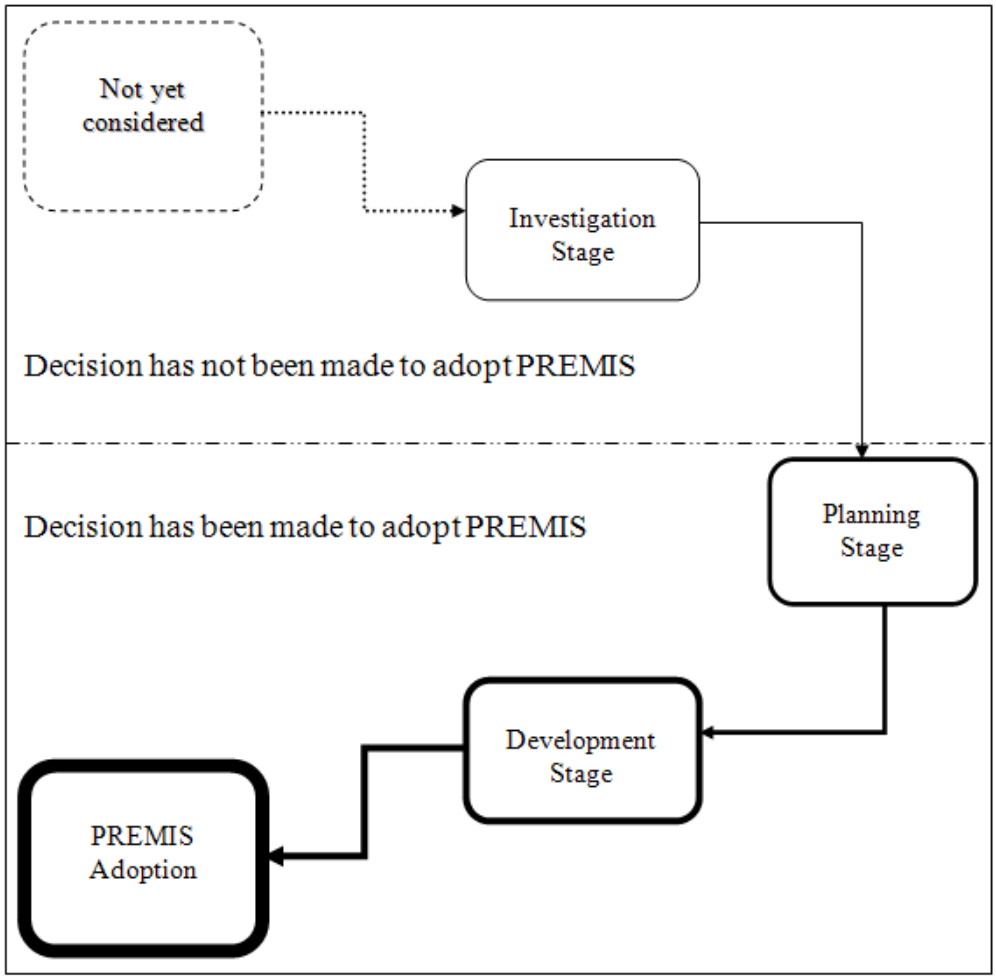

Figure 19. Overview of PREMIS adoption stages and decision status.

Using a scheme based on the two categories (Decision has been made to adopt and Decision has not been made to adopt) the entire interview data and the postings on the PREMIS Implementers' discussion lists were coded independently by a colleague of the researcher. The percent agreement was used to measure the reliability of coding between the researcher and the second coder. The computed value of the percent agreement was 0.79. Given that values over 0.70 are considered satisfactory in most situations (Neuendorf, 2002), the coding of the interview data and the postings on the PREMIS Implementers' discussion lists was deemed to be reliable and appropriate.

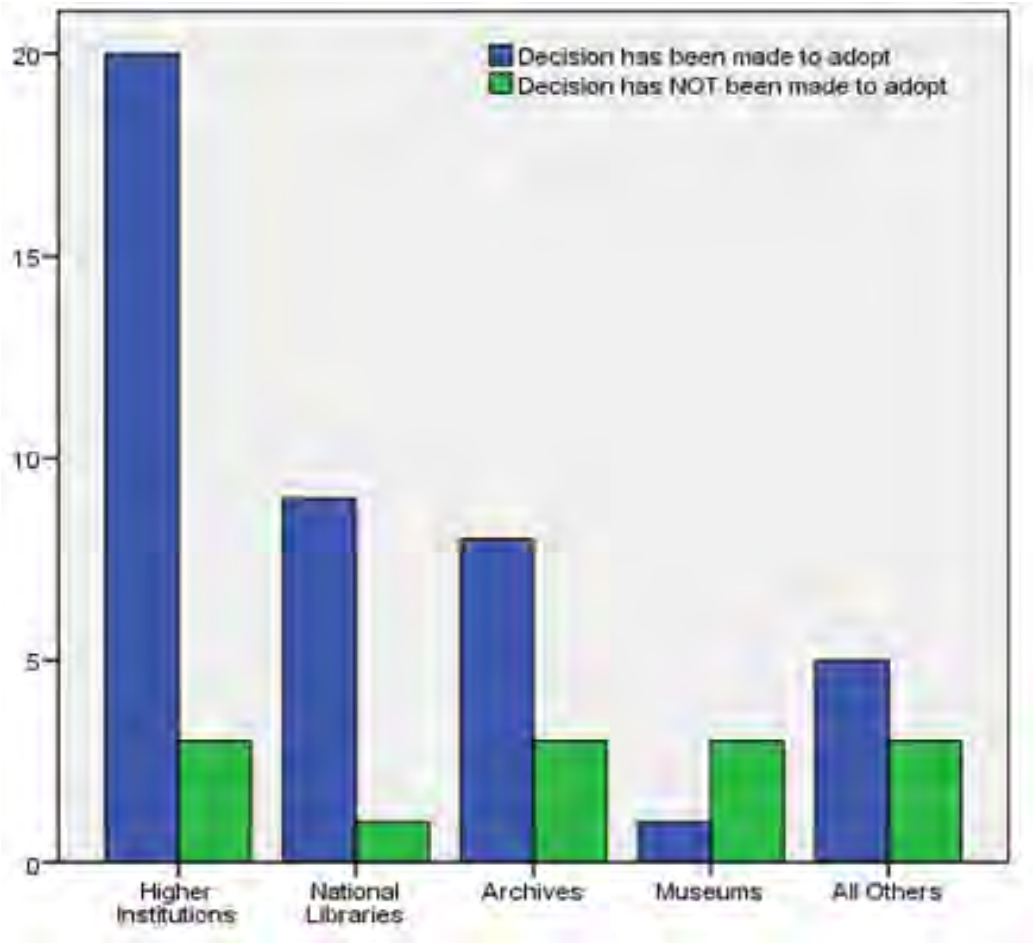

Figure 20. Adoption decision status by institutions type.

Figures 19 and 20 show the categories based on adoption decision status by institution types, as indicated by participants. Furthermore, since the researcher is involved in digital preservation activities, there might still have been some biases toward some or all of the institutions. Despite the possible biases, the new categories helped to find common characteristics among the participants and group data together, which otherwise seemed more widely spread out in the survey responses.

Findings Regarding Research Question – 1

In order to examine the factors that affect the adoption of PREMIS by cultural heritage institutions, the first research question in this study was: "What are the factors (i.e. attributes in the diffusion of innovations theory) that affect the adoption of PREMIS across the diverse cultural heritage institutions?"

To answer the first research question, this section focuses on analyzing and interpreting the statistical findings related to the six factors identified in the previous chapters of this document, namely: relative advantage, compatibility, complexity, trialability, observability, and institutional readiness. In addition to the statistical data, the findings are further supplemented and discussed with the relevant statements provided by the interviewees.

Relative Advantage

Relative advantage refers to the perceived advantages or benefits of the innovation. In light of this, this study analyzed the agreement levels of the respondents regarding their attitudes towards the relative advantages of the PREMIS. The four specific questions in the questionnaire analyzed and discussed in terms of PREMIS advantage over other innovations or the present circumstance are:

1. Implementing the PREMIS represents a desirable decision for institutions.
2. PREMIS enables institutions to better diagnose preservation issues.
3. PREMIS provides more opportunities for preservation.
4. Adopting PREMIS is resulting in overall improvements of digital preservation activities

Table 17

Responses to: 'Implementing the PREMIS Represents a Desirable Decision for our Institution'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	16	13.0	28.6	28.6
	Agree	21	17.1	37.5	66.1
	Neutral	19	15.4	33.9	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
Total		123	100.0		

Table 17 indicates that 66% of the respondents in the sample agreed with the statement that implementing the PREMIS represents a desirable decision for their respective institutions. Although about 34% of the responses are neutral, there were no respondents that did not agree with this statement. This high level of agreement from the respondents shows that most cultural heritage institutions have positive attitude towards implementing PREMIS.

As shown in Table 18, approximately 64% of the respondents agreed with the statement that PREMIS enables institutions to better diagnose preservation issues. However, one of the interview respondents, who responded in the affirmative, also noted that, "although PREMIS played significant role in analyzing preservation requirements, it can't accommodate all metadata needs of our institution." An interesting comment from another interview respondent was that "the PREMIS has helped to raise preservation awareness among senior management level."

Table 18

Responses to: 'PREMIS Enable Institution to Better Diagnose Preservation Issues'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	14	11.4	25.0	25.0
	Agree	22	17.9	39.3	64.3
	Neutral	19	15.4	33.9	98.2
	Disagree	1	.8	1.8	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
Total		123	100.0		

Table 19 shows the level of agreement with the statement "PREMIS provides more opportunities for preservation." The findings in the table indicate that 55% of the respondents agree with that statement compared to about 7% of the respondents who do not agree with the statement.

Table19

Responses to: 'PREMIS Provides More Opportunities for Preservation'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	14	11.4	25.0	25.0
	Agree	17	13.8	30.4	55.4
	Neutral	21	17.1	37.5	92.9
	Disagree	4	3.3	7.1	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
Total		123	100.0		

Regarding the findings in Table 19, one interview participant asserted that "PREMIS gave me the opportunity to learn from my peers and check my digital preservation and metadata issues understanding." An interesting comment from another interview respondent was that "the PREMIS has helped to raise preservation awareness among senior management level." In the above statements the respondents essentially emphasized the fact that although most cultural heritage institutions that adopted or plan to adopt PREMIS have made commitment to preservation metadata, the degree of commitment varies considerably. That also explains why more than one third of the respondents (37%) prefer to be neutral regarding that specific question.

Table 20

Responses to: 'Adopting PREMIS is Resulting in Overall Improvements of Digital Preservation Activities at my Institution'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	11	8.9	19.6	19.6
	Agree	17	13.8	30.4	50.0
	Neutral	22	17.9	39.3	89.3
	Disagree	2	1.6	3.6	92.9
	Strongly Disagree	4	3.3	7.1	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
Total		123	100.0		

Table 20 displays that about 50% of the respondents of this study agreed with the statement that "adopting PREMIS is resulting in overall improvement of digital preservation activities at my institution," compared to about 10% of the respondents who did not agree with this statement. An initial analysis of the number of cultural heritage institutions involved with PREMIS adoption presents a relatively positive picture. A closer look, however, reveals that the extent of PREMIS adoption in the respondents' institutions vary significantly. Considering the high number of cultural heritage institutions that are in the planning stage, it is no wonder that about 40% of the respondents had no opinions (neutral) as their institutions appear not to have undertaken

any meaningful adoption to measure the actual impact of PREMIS on their institutions' digital preservation activities in general.

Summary of Relative Advantage

Table 21 provides a summary and descriptive analysis of the relative advantage of adopting PREMIS. In general, PREMIS was well received and perceived by most cultural heritage institutions.

Table 21

Summary of Descriptive Statistics (Mean) of Relative Advantage

Factors	Institutions	N	Minimum	Maximum	Mean	Std. Deviation
Relative Advantage	Higher Education Institutions	23	1.00	3.50	2.0652	.64499
	Archives	11	1.00	3.75	2.3409	.91701
	National Libraries	10	1.25	2.25	1.9500	.36893
	Museums	4	1.75	3.50	2.6250	.72169
	Other Institutions	8	1.00	3.50	2.7188	.79550

The greater the perceived relative advantage of an innovation, the more rapid its rate of adoption will be. In support of this finding, the majority of the studies reviewed examined the role of perceived innovation characteristics in the adoption of innovation and relative advantage was found to be positively related to adoption.

Compatibility

Compatibility refers to the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters. The components of compatibility used to discuss whether the PREMIS fits in an institution's existing system environment or is compatible with the circumstances into which it will be adopted were:

1. PREMIS is compatible with existing policies and procedures.

2. Integrating PREMIS helps to acquire the basic metadata skills.

3. Flexibility of the PREMIS to make local adaptations without jeopardizing its effectiveness.

Table 22

Responses to: 'PREMIS is Compatible with the Institution's Long-Term Access Policy/Procedure'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	10	8.1	17.9	17.9
	Agree	24	19.5	42.9	60.7
	Neutral	20	16.3	35.7	96.4
	Disagree	1	.8	1.8	98.2
	Strongly Disagree	1	.8	1.8	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
	Total	123	100.0		

Lavoie (2008) noted that the PREMIS Data Dictionary for Preservation Metadata provided the first comprehensive specifications for preservation metadata produced from an international, cross-domain, consensus-building process. As can be seen from Table 22, most respondents (about 60%) agreed with the statement 'PREMIS is compatible with the Institution's long-term access policy/procedure.' Even though about 4% of the respondents do not agree with this statement, this high level of agreement of the respondents indicates that the cultural heritage institutions supported by PREMIS guidelines, which is applicable in a wide range of digital preservation contexts.

Table 23

Responses to: 'Integrating PREMIS would Help Other Members to Acquire the Basic Metadata Skills'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	7	5.7	12.5	12.5
	Agree	17	13.8	30.4	42.9
	Neutral	22	17.9	39.3	82.1
	Disagree	9	7.3	16.1	98.2
	Strongly Disagree	1	.8	1.8	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
Total		123	100.0		

Table 23 indicates that about 43% of the respondents in the sample agree with the statement that 'Integrating PREMIS in their institutions would help other members and collaborators to acquire the basic metadata skills.' However, a majority of the respondents (57%) are either neutral or do not agree with this statement. This high level of disagreement amongst the respondents shows that most cultural heritage institutions have reservations regarding PREMIS in terms of enhancing participants' metadata-related skills.

Most cultural heritage institutions use a combination of many metadata schemes and best community practices to address their diverse metadata and digital preservation needs. In this regard, many institutions said that their system is OAIS-compliant. Many respondents also said that they are already familiar with the metadata and digital preservation-related issues. DC (Dublin Core), METS (Metadata Encoding and Transmission Standard), MODS (Metadata Object Description Schema), and MIX (NISO Metadata for Images in XML) are among the most used metadata schemes used in combinations to support various metadata needs of cultural heritage institutions.

Table 24

Responses to: 'There is Room to Make Some Local Adaptations in how the PREMIS is Implemented Without Jeopardizing its Effectiveness'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	8	6.5	14.3	14.3
	Agree	18	14.6	32.1	46.4
	Neutral	26	21.1	46.4	92.9
	Disagree	3	2.4	5.4	98.2
	Strongly Disagree	1	.8	1.8	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
Total		123	100.0		

Woodyard-Robinson (2007) mentioned that conformance to the PREMIS Data Dictionary (PDD) is difficult to measure and open to interpretation. As can be seen from Table 24, it is no wonder that only 46% of the respondents in the sample agreed with the statement that "there is room to make some local adaptations in how the PREMIS is implemented without jeopardizing its effectiveness."

Also, the following direct quote from one of the interview participants reinforces the findings: "We are still trying to figure out what should we be doing to embed preservation into the working practice of our institution's repository."

Summary of Compatibility

Table 25 provides a summary of compatibility issues by institution, which paints a better overall picture and supports the above findings. One interview participant pointed out that compatibility, not only with existing institution's system but also with partners' and collaborators' systems and technology infrastructures, is a quite important factor that can affect PREMIS adoption.

Table 25

Summary of Descriptive Statistics (Mean) of Compatibility

Institutions		N	Minimum	Maximum	Mean	Std. Deviation
Compatibility	Higher Education Institutions	23	1.33	3.33	2.2754	.58303
	Archives	11	1.33	3.33	2.7273	.61134
	National Libraries	10	1.67	3.00	2.3667	.48305
	Museums	4	2.00	4.00	2.9167	.83333
	Other Institutions	8	2.00	3.33	2.5417	.53266

Complexity

In many diffusion of innovations studies, complexity is used as perceived ease of use. The three questionnaire items that analyzed complexity and discussed whether PREMIS is easy to use or not are:

1. Taking risks on new systems and standards that might enhance digital preservation management are worth the resources invested in them.

2. Technical assistance is available to our institution as we proceed with the implementation process.

3. My institution would be likely to adopt PREMIS only as long as it requires natural and incremental changes to the existing system.

Table 26

Responses to: 'Taking Risks on New Systems and Standards That Might Enhance Digital Preservation Management are Worth the Resource Invested in Them'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	10	8.1	17.9	17.9
	Agree	22	17.9	39.3	57.1
	Neutral	17	13.8	30.4	87.5
	Disagree	6	4.9	10.7	98.2
	Strongly Disagree	1	.8	1.8	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
Total		123	100.0		

Table 26 indicates the level of agreement among respondents with the statement, 'Taking risks on new systems and standards that might enhance digital preservation management are worth the resource invested in them.' The findings in the table show that about 57% of the respondents in the sample agreed with the statement, saying that their institutions are generally willing to try new systems and solutions that can tackle the digital preservation issues. About 30% of the respondents were neutral and about 13% of the respondents disagreed with the idea of taking risks on trying untested or unstable system is worthwhile regardless of the outcome.

Table 27

Responses to: 'Technical Assistance is Available to Our Institution as we Proceed with the Implementation Processes'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	6	4.9	10.7	10.7
	Agree	18	14.6	32.1	42.9
	Neutral	19	15.4	33.9	76.8
	Disagree	9	7.3	16.1	92.9
	Strongly Disagree	4	3.3	7.1	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
Total		123	100.0		

Table27 shows that only 43% of the respondents agreed with the statement, 'Technical assistance is available to our institution as we proceed with the implementation processes,' compared to the 34% of the respondents who were neutral, and about 23% of the respondents who did not agree with the statement. It is noteworthy that the findings in Table 27 differ from the findings in the other tables as the disagreement level of the respondents is 23% which is relatively high in comparison.

One of the interview participants mentioned that "our institution understands that digital preservation is vital, but we also understand that in practical terms it remains largely unresolved. At this point, technical assistance is not quite available, and we don't even know who should we be talking to."

Table 28

Responses to: 'My Institution would be Likely to Adopt PREMIS Only as long as it Requires Natural and Incremental Changes to the Existing System'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	4	3.3	7.1	7.1
	Agree	21	17.1	37.5	44.6
	Neutral	24	19.5	42.9	87.5
	Disagree	5	4.1	8.9	96.4
	Strongly Disagree	2	1.6	3.6	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
Total		123	100.0		

The perceived complexity of an innovation can inhibit adoption. In support of this finding, Table 28 shows that about 45% of the respondents in the sample believed that their institutions would be likely to adopt PREMIS only as long as it requires natural and incremental changes to the existing system. A number of respondents emphasized that iterative and incremental development help to ensure integration with existing systems and future preservation solutions. In this regard, one of interview participants said that “a modular approach to adopting components of the PREMIS was employed by our institution’s digital projects team.”

Summary of Complexity

Table 29 provides a summary and descriptive analysis of the degree of complexity of the PREMIS adoption. In general, PREMIS is perceived as relatively difficult to understand and use by most cultural heritage institutions.

The adopter’s evaluation of certain characteristics of the innovation can inhibit adoption. Interestingly, one of the respondents mentioned that only what is somehow complex is worthy of interest. However, most respondents did not agree with that and among other statements about complexity being inversely correlated with usefulness, one respondent noted that "in my opinion, PREMIS is a complex system, and an overly complex system doesn't do anyone any good."

Apparently what is complex and what is simple is relative and probably changes with time. Most diffusion of innovations researchers agree that if the tool is too complex to use, the less of a tool it becomes. As Van der Veen (2004) noted, the perceived

complexity of an innovation is negatively related to adoption. However, in many studies perceived complexity is insignificantly related to adoption.

Table 29

Summary of Descriptive Statistics (Mean) of Complexity

Institutions		N	Minimum	Maximum	Mean	Std. Deviation
Complexity	Higher Education	23	1.33	3.33	2.3623	.53099
	Archives	11	2.33	4.33	3.1515	.54495
	National Libraries	10	1.67	3.67	2.2333	.56765
	Museums	4	2.33	3.33	2.8333	.43033
	Other Institutions	8	2.33	3.33	2.8750	.43416

Trialability

Another important innovation characteristic is trialability, which refers to the degree to which an innovation may be experimented with on limited basis. The following three questionnaire items were used to analyze and discuss PREMIS' trialability:

1. My colleagues and I enjoy figuring out how to use PREMIS effectively for a variety of resource management situations in our institution.
2. My institution was one of the first institutions to experiment with PREMIS.
3. There has been healthy discussion about adopting the PREMIS within this institution.

Table 30

Responses to: 'My Colleagues and I Enjoy Figuring Out How to Use PREMIS Effectively for a Variety of Resource Management Situations in Our Institution'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	2	1.6	3.6	3.6
	Agree	18	14.6	32.1	35.7
	Neutral	20	16.3	35.7	71.4
	Disagree	13	10.6	23.2	94.6
	Strongly Disagree	3	2.4	5.4	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
Total		123	100.0		

Table 30 indicates the level of agreement among respondents with the statement, 'My colleagues and I enjoy figuring out how to use PREMIS effectively for a variety of resource management situations in our institution.' The findings in the table show that about 36% of the respondents in the sample agree with the statement that they have tried PREMIS in some way to supplement their institutions' digital preservation activities. About 35% of the respondents were neutral and about 29% of the respondents did not agree with the statement at all, which indicates that the vast majority of the respondents have little or no practical exposure to PREMIS.

Table 31

Responses to: 'My Institution was one of the First Institutions to Experiment with PREMIS'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	3	2.4	5.4	5.4
	Agree	12	9.8	21.4	26.8
	Neutral	6	4.9	10.7	37.5
	Disagree	19	15.4	33.9	71.4
	Strongly Disagree	16	13.0	28.6	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
Total		123	100.0		

Similarly, as can be seen from Table 31, only 27% of the respondents in the sample agreed with the statement that their institution was one of the first institutions to experiment with PREMIS. Not surprisingly, about 10% of the respondents were neutral and an overwhelming 63% of the respondents did not agree with the statement. The findings in Tables 30 and 31 go hand in hand with the overall adoption state of PREMIS discussed in previous sections. As depicted in Figure 17 and Table 15, fewer than 30% of the study participants indicated that their institutions were either in the *adopted* stage or *development (alpha-beta)* stage. This in part, explains why only 27% of the respondents in the sample believed that their institution is an innovator or early adopter of PREMIS.

Table 32

Responses to: 'There has been Healthy Discussion About Adopting the PREMIS Within This Institution'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	5	4.1	8.9	8.9
	Agree	19	15.4	33.9	42.9
	Neutral	13	10.6	23.2	66.1
	Disagree	12	9.8	21.4	87.5
	Strongly Disagree	7	5.7	12.5	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
Total		123	100.0		

Table 32 shows that about 43% of the respondents agreed with the statement, 'There has been healthy discussion about adopting the PREMIS within this institution' compared to the 23% of the respondents who were neutral, and 34% of the respondents who did not agree with the statement at all. Again the disagreement level of the respondents is somewhat high in comparison to the previous response in Table 30. Although this question aims to investigate trialability, it can also be applied to digging deeper into identifying institutions which support and use PREMIS extensively. Most interviewees believed that administrative support has a great impact. The top management influence in the adoption of PREMIS further discussed in the "Institutional Readiness" section of this document.

Summary of Trialability

Table 33 provides a summary and descriptive analysis of the trialability of PREMIS. In light of the aforementioned analysis, the vast majority of cultural heritage institutions seem conservative about change. In support of these findings, one interviewee quoted and affirmed the conventional wisdom that change is inevitable, but cultural heritage institutions chose to differ: "[Museums] go through radical change only at very selective moments in their history, and they do so cautiously."

In this regard, Wejnert (2002) noted that the familiarity associated with an innovation relates to how radical it is. When the apparent familiarity of an innovation is increased, the perception of risk by adopters is substantially reduced, facilitating adoptive behavior.

Table 33

Summary of Descriptive Statistics (Mean) of Trialability

Institutions		N	Minimum	Maximum	Mean	Std. Deviation
Trialability	Higher Education Institutions	23	1.67	4.67	3.0290	.74477
	Archives	11	2.00	4.33	3.7273	.81402
	National Libraries	10	1.67	3.33	2.4333	.54546
	Museums	4	2.33	5.00	3.6667	1.21716
	Other Institutions	8	2.67	4.67	3.4167	.81162

Observability

Observability refers to the degree to which the results of an innovation are visible to others. The four questionnaire items analyzed and discussed in observability, or results that can be observed, are:

1. Cultural heritage institutions are enthusiastic about the PREMIS.
2. Adopting PREMIS is improving the image of my institution.
3. There is limited research literature that shows PREMIS role and significant improvements in digital preservation as a result of PREMIS adoption.
4. The experience of other organizations adopting the PREMIS convinces me of its effectiveness.

Table 34

Responses to: 'Cultural Heritage Institutions are Enthusiastic about the PREMIS'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	5	4.1	8.9	8.9
	Agree	14	11.4	25.0	33.9
	Neutral	30	24.4	53.6	87.5
	Disagree	6	4.9	10.7	98.2
	Strongly Disagree	1	.8	1.8	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
	Total	123	100.0		

According to Table 34, about 34% of the respondents in the sample agreed with the statement cultural heritage institutions are enthusiastic about the PREMIS. As observed, about 43% of the respondents were neutral, whereas about 13% of the respondents (who disagreed or strongly disagreed) believed that cultural heritage institutions were not enthusiastic about the PREMIS.

Table 35

Responses to: 'Adopting PREMIS is Improving the Image of my Institution'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	7	5.7	12.5	12.5
	Agree	13	10.6	23.2	35.7
	Neutral	32	26.0	57.1	92.9
	Disagree	1	.8	1.8	94.6
	Strongly Disagree	3	2.4	5.4	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
Total		123	100.0		

Table 35 shows that about 36% of the respondents agreed with the statement, 'Adopting PREMIS is improving the image of my institution,' whereas a staggering 57% of the respondents were neutral. About 7% of the respondents reported that adopting PREMIS was not improving the image of their respective institutions.

Table 36

Responses to: 'There is Limited Research Literature that Shows PREMIS Role and Significant Improvements in Digital Preservation as a Result of PREMIS Adoption'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	10	8.1	17.9	17.9
	Agree	21	17.1	37.5	55.4
	Neutral	22	17.9	39.3	94.6
	Disagree	3	2.4	5.4	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
Total		123	100.0		

As shown by Table 37, a majority (56%) of the respondents believed that there was limited research literature that shows PREMIS role or significant improvements in digital preservation as a result of PREMIS adoption. About 45% of the respondents were neutral, whereas only about 5% of the respondents believe that there are enough resources that show PREMIS' contributions in facilitating digital preservation activities.

Similarly, as shown by Table 37, only about 23% of the respondents agree with the statement, 'The experience of other organizations adopting the PREMIS convinces me of its effectiveness.' The majority (55%) of the respondents had no opinion (neutral), whereas, about 22% disagreed with that statement.

Table 37

Responses to: 'The Experience of Other Organizations Adopting the PREMIS Convinces me of its Effectiveness'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	6	4.9	10.7	10.7
	Agree	7	5.7	12.5	23.2
	Neutral	31	25.2	55.4	78.6
	Disagree	10	8.1	17.9	96.4
	Strongly Disagree	2	1.6	3.6	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
Total		123	100.0		

Summary of Observability

Table 38 provides a summary and descriptive analysis of the observability. Based on the above discussion, the vast majority of cultural heritage institutions participated in the study evaluated observability as an important factor.

Table 38

Summary of Descriptive Statistics (Mean) of Observability

Institutions		N	Minimum	Maximum	Mean	Std. Deviation
Observability	Higher Education Institutions	23	1.75	4.00	2.6304	.48775
	Archives	11	1.00	3.25	2.6591	.66401
	National Libraries	10	1.75	3.00	2.3750	.39528
	Museums	4	2.25	3.00	2.6250	.32275
	Other Institutions	8	2.25	3.75	3.0312	.47127

In this regard, Lavoie (2008) mentioned that the PREMIS maintenance activities have devoted considerable effort toward educational outreach in the digital preservation community. However, as shown in Tables 35 and 36 earlier, few of the respondents believed that there were enough resources that show PREMIS' significant contributions in facilitating digital preservation activities.

Institutional Readiness

A number of determinants for adoption relate to institutional readiness. The questionnaire addresses a range of factors influencing PREMIS adoption within the context of cultural heritage institutions. For example, the presence of relevant knowledge and experience facilitate PREMIS adoption; other examples are organizational readiness in terms of preservation value, adoption of related standards, etc.

There are a number of items both in the survey and in the interview questions that refer to the perception that adequate resources are being dedicated in the cultural

heritage institution to facilitate PREMIS adoption, including: recognition of need, staffing, budget, and so forth. Many of these items were discussed and analyzed (qualitatively and quantitatively) within the context of cultural heritage institutions. Specifically, for the purpose of this study, institutional readiness was assessed using the following four specific questions from the survey:

1. My institution has the resources necessary to support the ongoing adoption of the PREMIS.
2. Employees involved in the implementation of the PREMIS know their efforts are appreciated by the institution.
3. My institution is well informed about the PREMIS.
4. My institution has the know-how to adopt the PREMIS.

In Table 39, the survey results are presented for one of the perceived allocation of resources questions. As observed, 41% of the respondents agreed with the statement, 'My institution has the resources necessary to support the ongoing adoption of the PREMIS.' What is remarkable is that the vast majority (about 58%) of the respondents had no opinions or did not agree with that statement.

Table 39

Responses to: 'My Institution has the Resources Necessary to Support the Ongoing Adoption of the PREMIS'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	4	3.3	7.1	7.1
	Agree	19	15.4	33.9	41.1
	Neutral	21	17.1	37.5	78.6
	Disagree	7	5.7	12.5	91.1
	Strongly Disagree	5	4.1	8.9	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
Total		123	100.0		

The main source of funding for digital projects-related activities mentioned in the survey was the operation operational budget of individual institutions. However, as Table 40 shows, almost three-quarters of the survey respondents said that grant funding (external and/or internal) is an integral part of digital projects funding and was considered as their prime source of funding. Overall, fee-for-service accounted for less than one fifth of funds. Although some institutions mentioned contracts for digital services as a funding source, this figure was lower in cultural heritage institutions, as most of them are not for profit institutions. Other funding sources include charitable trusts, foundation gifts, government funds, and corporate sponsorship.

Table 40

Responses to: 'Sources of Funding for Digital Projects and Related Activities'

Sources of Funding		Frequency	Percent
	Grant funded externally	55	57.9%
	Grant funded internally	14	14.7%
	Fee for service	17	17.9%
	Institution's operational budget	75	78.9%
	Other	8	8.4%
	Total Valid	95	77.2
	Missing System	28	22.8
Total		123	100

Table 41 shows the level of agreement with the statement 'Employees involved in the implementation of the PREMIS know their efforts are appreciated by the institution.' Again, the findings in the table indicated that about 71% of the respondents either did not agree (about 20%) or were neutral (51%) compared to about 29% of the respondents, who agreed with that statement.

Table 41

Responses to: 'Employees Involved in the Implementation of the PREMIS Know that Their Efforts are Appreciated'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	4	3.3	7.1	7.1
	Agree	12	9.8	21.4	28.6
	Neutral	29	23.6	51.8	80.4
	Disagree	6	4.9	10.7	91.1
	Strongly Disagree	5	4.1	8.9	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
Total		123	100.0		

According to Table 42, about 34% of the respondents in the sample agreed with the statement, 'My institution is well informed about the PREMIS.' As observed, about 26% of the respondents were neutral, whereas significant number of respondent (40%) did not agree with that statement at all. Similarly, Table 43 shows a similar picture since fewer than 50% of the respondents in the sample agreed with the statement, 'My institution has the know-how to adopt the PREMIS.'

Table 42

Responses to: 'My Institution is Well Informed about the PREMIS'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	5	4.1	8.9	8.9
	Agree	14	11.4	25.0	33.9
	Neutral	15	12.2	26.8	60.7
	Disagree	13	10.6	23.2	83.9
	Strongly Disagree	9	7.3	16.1	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
	Total	123	100.0		

Although most respondents relate these questions (Tables 42 and 43) with the presence of an innovator that can initiate the change process, one interview participant viewed the issue as institutional matter, and he emphasized the need to identify a set of priority conditions upon which to focus initial efforts and provide resources to encourage innovation with in the institution.

As noted by many innovation adoption researchers, (such as Rogers, 2003), the IT infrastructure sophistication is considered as one of the main institution characteristics that can influence related innovation adoption. In this regard the following section discuss cultural heritage institutions IT infrastructure sophistication in light of the possible implications on PREMIS adoption.

Table 43

Responses to: 'My Institution has the Know-how to Adopt the PREMIS'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	8	6.5	14.3	14.3
	Agree	19	15.4	33.9	48.2
	Neutral	20	16.3	35.7	83.9
	Disagree	6	4.9	10.7	94.6
	Strongly Disagree	3	2.4	5.4	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
Total		123	100.0		

IT infrastructure Sophistication

A number of determinants of adoption relate to the institutional readiness. The questionnaire addressed a range of factors influencing PREMIS adoption within the context of cultural heritage institutions. The identified general institution characteristics that are related to PREMIS adoption include: IT infrastructure sophistication, perceived allocation of resources, the presence of innovation roles, metadata and digital preservation related knowledge, to name just a few.

Table 44 shows the widely adopted content management solutions among cultural heritage institutions. About half (49%) of the respondents used some sort of locally

developed systems. In addition, not surprisingly, more than 50% of the respondents mentioned that they use “other” content management tools as well.

Table 44

Six Most Frequently Identified Content Management Solutions

Content Management Solutions	Frequency	Percent %
Locally developed system	44	48.4
DSPace	17	18.7
Fedora	10	11.0
Content DM	6	6.7
dIgitool	6	6.7
Greenstone	5	5.5
Other	46	50.5
Total Valid	91	74.0
Missing	32	26.0
Total	123	100

Some of the content management software categorized as *others* include: ADIS/BMS, PTFS, Artesia DAM/TEAMS, Canadian Forces Artefact Management, DAITSS, DIAS, Documentum, FileMaker Pro, Glomas Star, GNU Eprint, Inmagic, iRods, Keystone, Oracle RDMS, PastPerfect Program, PortFolio, RDF system, SiteSearch, TeleScope, Vernon, and VUBIS.

As shown in Table 45, most cultural heritage institutions use a combination of many metadata schemes to address their diverse metadata needs of cultural heritage institutions. DC (about 43%), MODS (43%), and MIX (about 22%) are among the highest metadata schemas that used in combinations to support and represent various Archival Information Packages in diverse cultural heritage institutions archival systems.

Table 45

Four Most Frequently Identified Metadata Schemes and Best Community Practices Used by Cultural Heritage Institutions

Metadata Schemes and Best Community Practices	Frequency	Percent %
Dublin Core	58	64.4
METS	39	43.3
MIX or Z39.87	20	22.2
Creative commons	9	10.0
Other	47	52.2
Total Valid	90	73.2
Missing System	33	26.8
Total	123	100

Most of the participants (about 41%) said that their systems are OAIS-compliant. Also many institutions (43%) already use the Metadata Encoding and Transmission Standard (METS), this finding goes hand in hand with Guenther's (2008) assertion that most cultural heritage institutions are looking at METS as a container to include PREMIS metadata along with other information about and links to the digital objects.

In Table 45, more than half of the respondents also mentioned that they use other types of metadata schemes. Some of the metadata schemes and community standards used by cultural heritage institutions and categorized as *others* include:

- Alto
- AUDIOMD
- CEDARS
- CHIN - Canadian Museums and Galleries
- DDI - Data Documentation Initiative
- EAD
- ETD-MS
- FGDC
- IPTC and EXIF
- ISO 15489
- LMER -Long-term preservation Metadata for Electronic Resources
- MARC
- MIDAS
- MODS
- MPEG21
- Museumdat - (developed by Deutscher Museumsbund)
- NEDLIB
- NLA - (developed by Australia National Library)
- NLNZ (New Zealand)
- OCLC Digital archive
- ONIX
- PBCore
- Schema for Rights
- TEI
- UNTLMS - University of North Texas Libraries Metadata Schema
- VIDEOMD
- VRA

Summary of Institutional Readiness

Table 46 provides a summary and descriptive analysis of the institutional readiness. The findings show that almost all institution types believe that institutional readiness is one of the powerful factors that can significantly influence PREMIS adoption. In support of these findings, several interviewees noted that institutions need to create an environment that fosters innovations. In this regard one of the respondents said that "creating an infrastructure to support digital preservation will facilitate PREMIS adoption." Another interviewee focused on training issue: "preparing the workforce to better operate in a digital world of rapid change is critical."

Table 46

Summary of Descriptive Statistics (Mean) of Institutional Readiness

Institutions		N	Minimum	Maximum	Mean	Std. Deviation
Institutional Readiness	Higher Education Institutions	23	1.50	4.25	2.7500	.82572
	Archives	11	2.25	5.00	3.2045	.74009
	National Libraries	10	1.00	2.75	2.1250	.50346
	Museums	4	2.50	5.00	3.9375	1.04831
	Other Institutions	8	2.00	4.00	3.1250	.79057

Summary of Research Question-1

The questionnaire addressed a range of factors influencing PREMIS adoption within the context of cultural heritage institutions. Based on the analysis of the data and as can be seen from the correlations, descriptive statistics summary, and regression tables (Tables 47, 48, and Appendix F), all the factors in the Rogers model are relevant and contributed to the adoption of PREMIS by the individual participants and, hence, by their respective cultural heritage institutions. The researcher has also conducted a factor analysis to explore certain properties of correlations. However, factor analysis can be only as good as the data allows, and due to the small sample size, the factors could not be identified clearly using factor analysis. Appendix F shows coefficients for the six variables and correlations among adoption factors and adoption level.

Table 47

Descriptive Statistics of All the Six Factors

	N	Minimum	Maximum	Mean	Std. Deviation
Relative Advantage	56	1.00	3.75	2.2321	.72434
Compatibility	56	1.33	4.00	2.4643	.60194
Complexity	56	1.33	4.33	2.6012	.61437
Trialability	56	1.67	5.00	3.1607	.86688
Observability	56	1.00	4.00	2.6473	.51956
Institutional Readiness	56	1.00	5.00	2.8661	.88029

As part of an attempt to answer Research Question - 1, composite scores, based on the responses to individual items by the participants, were calculated for the dependent variable, adoption level, and all the six independent variables (factors) (relative advantage, compatibility, complexity, trialability, observability, and institutional readiness). In order to determine the effect of these six factors on adoption level, a regression analysis was conducted. The regression model tested was:

$y = b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + a$, where,

y= adoption level

x_1=Relative Advantage

x_2=Compatibility

x_3=Complexity

x_4=Trialability

x_5=Observability, and

x_6=Institutional Readiness

Table 48

Regression analysis of adoption level on the six factors (Relative Advantage, Compatibility, Complexity, Trialability, Observability, and Institutional Readiness)

		Sum of Squares	*df*	Mean Square	*F*	*p*	*R*	*R-Square*
Regression		33.438	6	5.573	9.127	.000(a)	.726	.528
Residual		29.920	49	.611				
Total		63.357	55					

a Predictors: (Constant), Institutional Readiness, Observability, Compatibility, Complexity, Relative Advantage, Trialability

Results of the analysis (Table 48) showed that adoption level has a statistically significant relationship with the six factors (R-square=.528, p=.000). As shown in Table 49, the six predictors explain a significant percentage of the variance in the dependent variable, adoption level (about 53%). The regression analyses results confirm the fact that institutional readiness, observability, compatibility, complexity, relative advantage, and trialability influence adoption level as stated in Rogers' model. This is consistent with the findings of the analyses of the survey and interview data above.

Analysis of the data revealed that all of the six factors influence the adoption of PREMIS, albeit in varying degrees. Although trialability and observability are among the less-commonly used innovation attributes in some studies (Agarwal & Prasad, 1997) the relationship between perceived trialability and PREMIS adoption has been found positive. In support of this finding, Tornatzky and Klein (1982) noted that the perception of attributes of the innovation can predict the adoption, with some degree of consistency across various settings. The greater the perceived characteristics of an innovation, the more rapid its rate of adoption will be.

Figure 21 summarizes the identified factors that influence PREMIS adoption. Based on the standardized coefficients values in Appendix-VI, among the six variables, institutional readiness, trialability, and relative advantage were the three best predictors of PREMIS adoption. The relative contributions of each predictor to the variance accounted for R^2 also summarized in chapter 5.

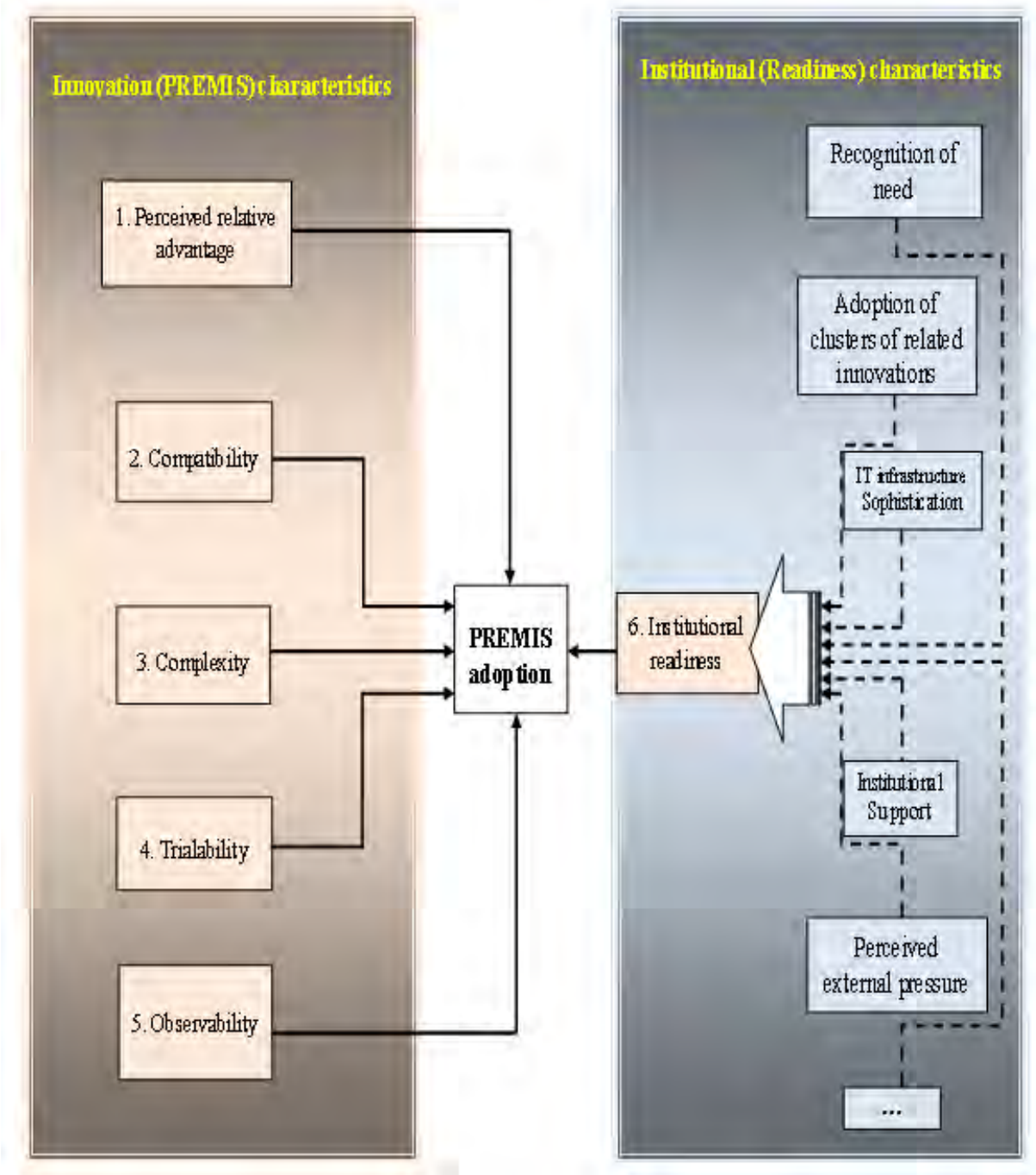

Figure 21. Summary of factors affecting PREMIS adoption.

Findings Regarding Research Question-2

The second research question for this study was: "What influence did PREMIS have on their decision to adopt preservation metadata schemes and on current practices of preservation metadata management in the cultural heritage institutions?" A combination of data from the literature, interviews, and the items from the survey questionnaire were analyzed and discussed to answer this research question. Comparisons were made between the findings in the literature review and the findings from the research study both qualitatively and quantitatively. To reinforce the findings, some of the research participants' statements were quoted directly.

Cultural heritage institutions accept the notion that maintaining usable and sustainable digital collections requires a complex set of actions. In this regard, most respondents agreed that preservation metadata is crucial to implementing reliable, usable, and sustainable digital libraries. Table 49 shows that more than 91% of the respondents in the sample believed that preservation metadata help resource managers in managing, analyzing data, and solving problems. In support of this, Guenther (2008) stated that long-term digital repositories around the world are looking for guidance on the implementation of preservation metadata.

Table 49

Responses to: 'Preservation Metadata Helps Resource Managers in Managing, Analyzing Data, or Solving Problems.'

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	21	17.1	37.5	37.5
	Agree	30	24.4	53.6	91.1
	Neutral	5	4.1	8.9	100.0
	Total	56	45.5	100.0	
Missing	System	67	54.5		
Total		123	100.0		

However, the institutional context for preservation metadata requirements may differ across cultural heritage institutions. In this regard, despite the role of preservation metadata in digital resource life cycle management, a number of interview participants mentioned that they viewed PREMIS adoption in light of their institutions' specific characteristics. As can be seen from their statements, many emphasized that the institutional context actually matters when it comes to adopting PREMIS. One respondent said that "PREMIS is more library-centric and our team members are cautious in recommending full PREMIS adoption."

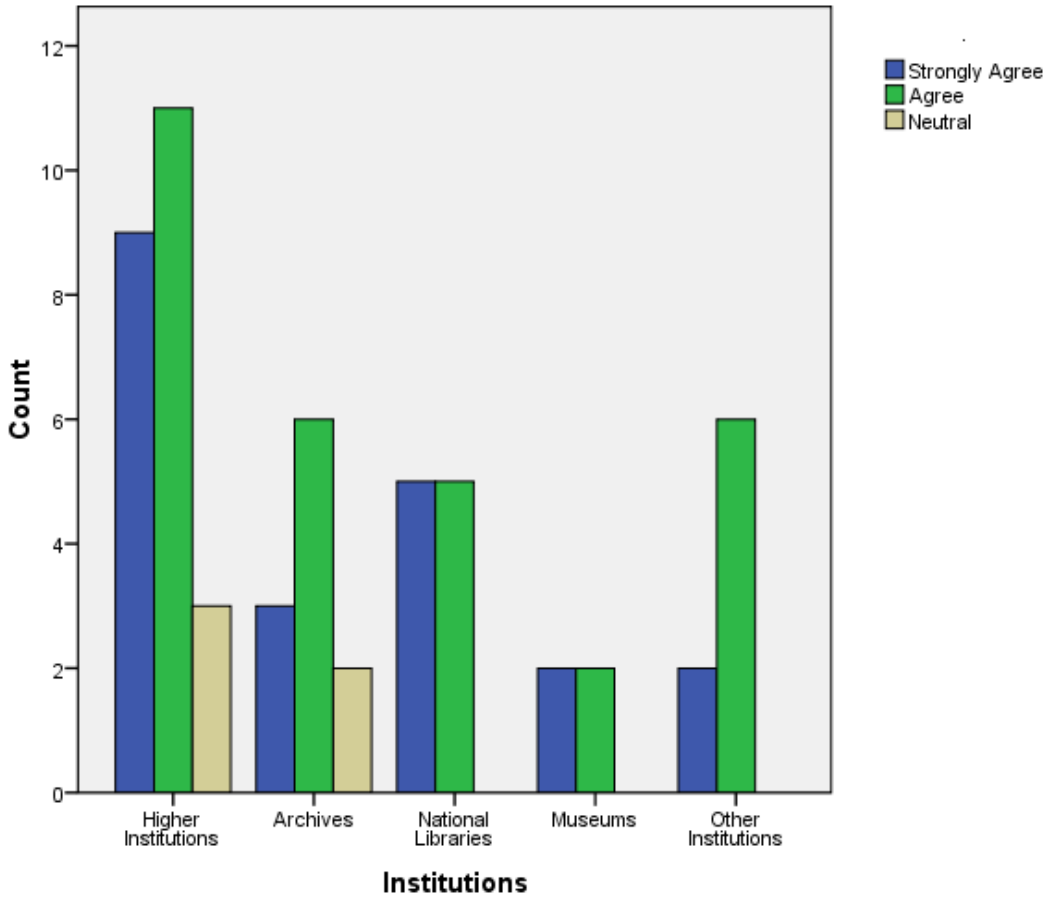

Figure 22. Agreement level by institution.

Although there are some commonalities among cultural heritage institutions, there are notable differences. Many believe that ground-breaking digital preservation ideas can come from anyone, or even from outside of the cultural heritage community. This is also reflected in the high level of agreement across kinds of cultural heritage institutions in Figure 22. One of the interview respondents even mentioned the OAIS as a good example of digital preservation solution, although it came from the space science community rather than originating within cultural heritage community.

The following statement from one of the interview respondents sums up the views of many participants: “While we can be informed by PREMIS and what worked elsewhere in terms adopting preservation metadata, we must take account of our own local specific conditions before implementing change.”

Using PREMIS with Other Metadata Schemas and Tools

Although PREMIS played significant role in analyzing preservation requirements, it cannot accommodate all metadata requirements. As Dappert and Enders (2008) noted, no single existing metadata schema accommodates the representation of descriptive, preservation, and structural metadata.

As shown in Table 44, most cultural heritage institutions use a combination of metadata schemes to address their diverse metadata needs. Many respondents (about 43%) indicated that their institutions use the Metadata Encoding and Transmission Standard (METS) to implement metadata in digital library applications. Guenther (2008) noted that many implementers of PREMIS have considered METS as a container to include PREMIS metadata along with other descriptive information about and links to the digital objects. In Figure 23, Guenther’s mapping of PREMIS entities shows the relation to METS sections. Thick arrows show applicable subsections in METS for the named PREMIS entities; the thin arrows show links from one PREMIS entity to another METS subsection.

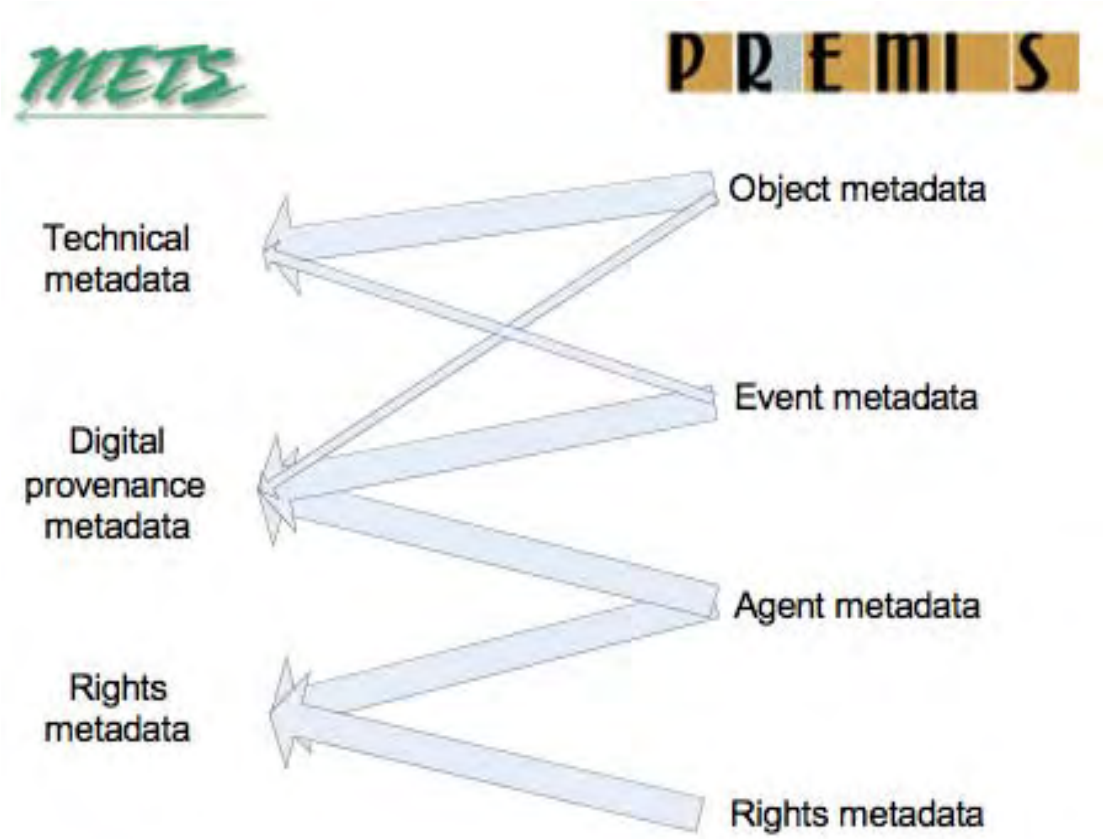

Figure 23. Mapping PREMIS entities to METS metadata sections (Guenther, 2008).

As discussed in the previous section of this document, most cultural heritage institutions have a great deal of experience with other metadata management tools. As can be seen from the profile of current technology infrastructure in Tables 44 and 45, a number of cultural heritage institutions were running up-to-date and fairly sophisticated information system. Since most institutions install and use a variety of tools, respondents were asked to identify tools that they use for preservation metadata generation and/or extraction of technical metadata. Some of the highly-used, externally available (or locally developed) tools are identified in Table 50.

Table 50

Tools for Preservation/Technical Metadata Generation and/or Extraction

		Yes	No	Don/t Know	Total
JHOVE	#	36	25	4	65
	%	55.4%	38.5%	6.2%	100%
DROID	#	19	35	3	57
	%	33.3%	61.4%	5.3%	100%
NLNZ	#	9	43	1	53
	%	17%	81.1%	1.9%	100%
GDFR	#	2	45	4	51
	%	3.9	88.2	7.8	100%
NOID	#	4	43	4	51
	%	7.8	84.3	7.8	100%
Other	#	5	0	0	5
	%	100%	0%	0%	100%

As can be seen from Table 50, most respondents use one or more format identifications tools. The open source JHOVE characterization tool was identified as one of the widely used components of many cultural heritage institutions' digital preservation workflows. Currently (in 2008), the California Digital Library (CDL), Portico, and Stanford University have received funding from the Library of Congress, under its National Digital Information Infrastructure Preservation Program (NDIIPP) initiative, to

collaborate on a two-year project to develop a next-generation JHOVE2 architecture for format-aware characterization.

Digital Record Object Identification (DROID) is another widely used tool developed by The National Archives to perform automated batch identification of file formats. It is designed to identify the precise format of all stored digital objects, and to link that identification to a central registry of technical information about that format and its dependencies.

The NLNZ Metadata Extraction tool is a Java-based application developed for use by the National Library of New Zealand. It extracts specific information regarding the technical composition of a digital object.

The Global Digital Registry (GDFR) is a collaborative project of the Harvard University Library, NARA, and OCLC with funding provided by the Andrew W. Mellon Foundation. GDFR is available only for testing and review, but two respondents said that they are already using it. Other respondents also mentioned that they will use GDFR when it is available for production systems.

Other format identifications tools identified by respondents include: the AHDS Collections Management System, DigiTool technical metadata extraction tool, and OCLC Metadata Extraction Tools. All these format identifications tools including JHOVE, DROID, NLNZ Metadata extractor, and so forth (Table 51) are designed to provide basic information on the file format. However, they may not provide sufficient detail to preserve the digital resource.

Summary of Research Question-2

Based on the findings, most cultural heritage institutions believe that PREMIS facilitates preservation management activities and their respective institutions informed by the PREMIS Data Dictionary. In support of those findings, Woodyard-Robinson (2007) indicated that since the publication of the PREMIS Data Dictionary version 1.0 in early 2005, a number of repositories have adopted preservation metadata or have created crosswalks with existing systems.

As noted by many innovation adoption researchers, the spread of an innovation is primarily an issue of knowledge-sharing through social networks and there are non-linear patterns in the social network that make some individuals or institutions more essential than others to the spread of an innovation (Rogers, 2003).

The PREMIS Data Dictionary is intended to be technically neutral. That is, no assumptions are made as to the specific digital archiving system, the database architecture, or the archiving technology. Nor are assumptions made about metadata management, such as whether metadata is stored locally or in an external registry, or whether metadata units are recorded explicitly or known implicitly because of repository policies (PREMIS Working Group, 2005). Thus, despite the application of heterogeneous tools and systems (shown in Tables 43 and 44), PREMIS' technical neutrality principle allows for applicability in a wide range of contexts, regardless of the specific type of implementation used for collecting, storing, maintaining, and exchanging the PREMIS metadata. Such flexibility allows cultural heritage institutions to use the specification as a key piece of its infrastructure and to adapt it to its own needs. However, this flexibility of PREMIS does not seem to be well understood by many potential adopters.

Findings Regarding Research Question-3

The third and final research question for this study was: “Among the diverse cultural heritage institutions that adopted or plan to adopt PREMIS, are there commonalities in factors that may affect the decision-making process? Are there differences by type of institution?” Again, a combination of data from the literature, interviews, and the items from the survey questionnaire were analyzed both qualitatively and quantitatively to answer this research question.

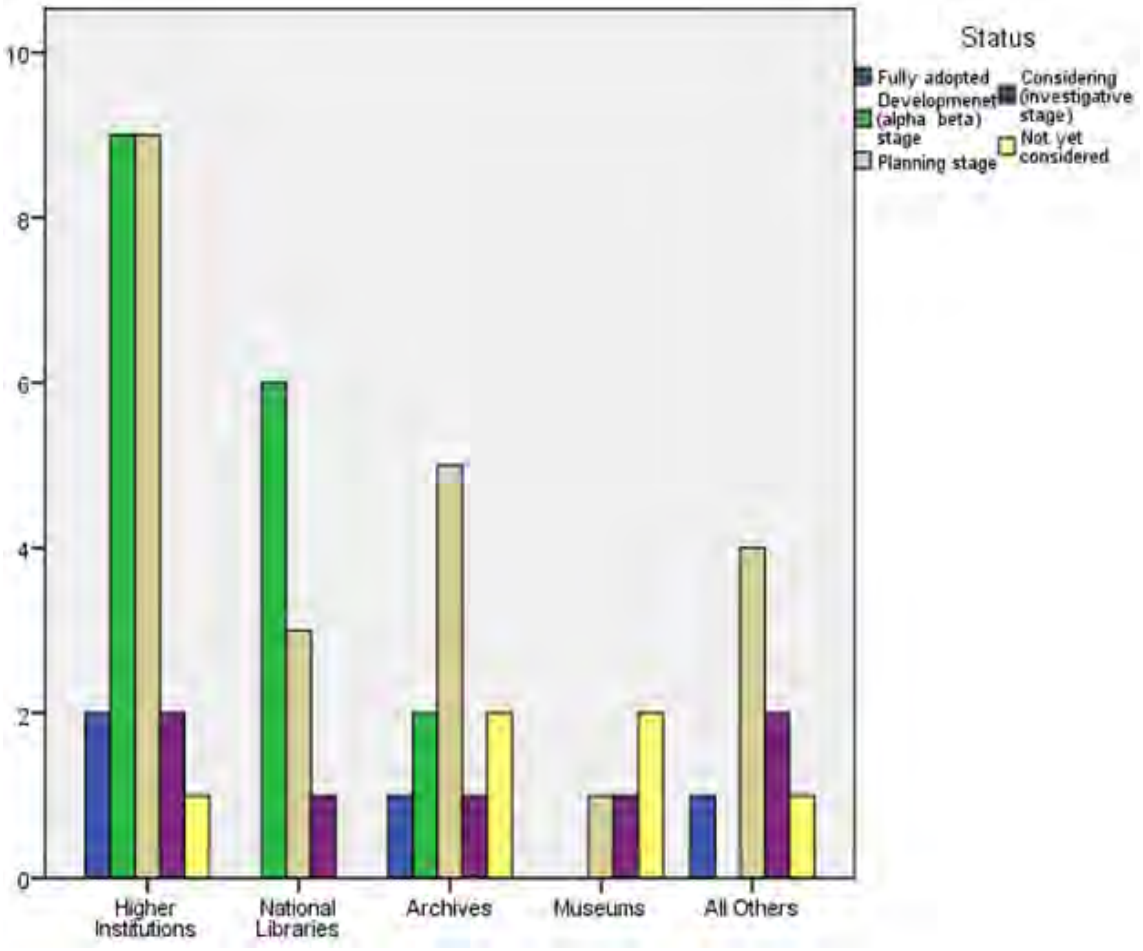

Figure 24. PREMIS adoption status by institution type.

Table 51

Institutions' Status by Adoption Decision Category Cross-Tabulation

		Decision has been made to adopt	Decision has NOT been made to adopt	Total
Higher Education Institutions	Count	20	3	23
	% within Higher Education Institutions	87.0%	13.0%	100.0%
	% within Decision-Type	46.5%	23.1%	41.1%
	% of Total	35.7%	5.4%	41.1%
National Libraries	Count	9	1	10
	% within National Libraries	90.0%	10.0%	100.0%
	% within Decision-Type	20.9%	7.7%	17.9%
	% of Total	16.1%	1.8%	17.9%
Archives	Count	8	3	11
	% within Archives	72.7%	27.3%	100.0%
	% within Decision-Type	18.6%	23.1%	19.6%
	% of Total	14.3%	5.4%	19.6%
Museums	Count	1	3	4
	% within Museums	25.0%	75.0%	100.0%
	% within Decision-Type	2.3%	23.1%	7.1%
	% of Total	1.8%	5.4%	7.1%
All Others	Count	5	3	8
	% within Other Institutions	62.5%	37.5%	100.0%
	% within Decision-Type	11.6%	23.1%	14.3%
	% of Total	8.9%	5.4%	14.3%
Total	Count	43	13	56
	% within All Institutions	76.8%	23.2%	100.0%
	% within Decision-Type	100.0%	100.0%	100.0%
	% of Total	76.8%	23.2%	100.0%

Table 51 and Figure 24 show the results of adoption stage and institutions' PREMIS adoption decision categories cross-tabulations. This categorization was based on respondents' self-assignment. It is interesting to note the institutional differences both in number of participations, PREMIS adoption stages, and/or decision categories.

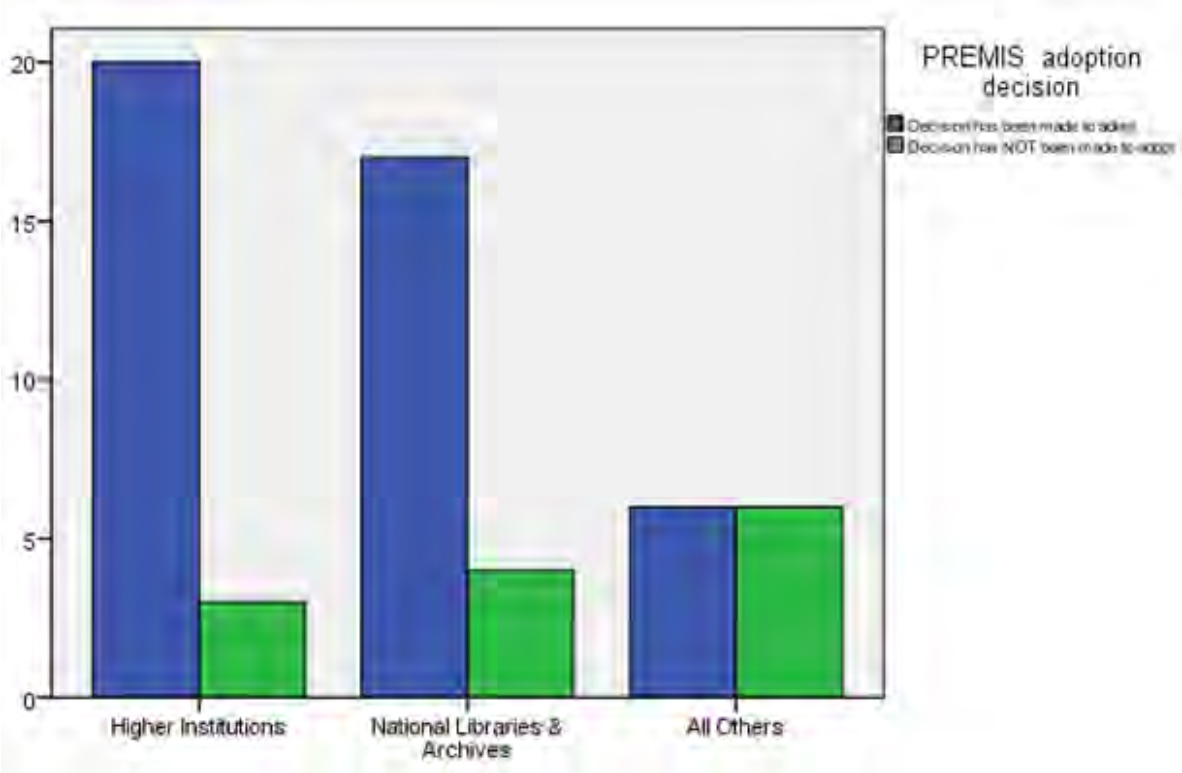

Figure 25. PREMIS adoption decision status by institution type.

As can be seen from Figures 24 and 25, higher education institutions, national libraries, and archives tend to show relatively high level of participation and engagement in terms of PREMIS adoption compared to museums and other type of cultural heritage institutions. Chapter 5 provides further analysis in light of Rogers' (2003) adopter categories, namely: innovators, early adopters, early majority, late majority, and laggards.

There are common factors in the decisions of cultural heritage institutions regarding whether to adopt or not to adopt PREMIS. Table 52 lists eight of the most frequently identified stimulants factors that facilitate PREMIS adoption in cultural heritage institutions.

Table 52

Eight Most Frequently Identified Stimulants or Factors that Facilitate PREMIS Adoption by All Respondents

Factors		Frequency	Percent %
Adopting the PREMIS is seen as a practical necessity by our institution.		33	58.9
My institution has the resources necessary to support the initial adoption of the PREMIS.		22	39.3
My institution has enough technical knowledge to adopt the PREMIS.		20	35.7
Interest from the decision-makers within our institution.		20	35.7
Most cultural heritage institutions are adopting the PREMIS or seriously considering it.		14	25.0
Benefits will outweigh costs when it comes to adopting the PREMIS at our institution.		18	32.1
The PREMIS is compatibility with existing system.		12	21.4
From a technical standpoint, it is/will be easy to implement the PREMIS.		7	12.5

Cultural heritage institutions that adopt PREMIS also identified possible barriers that may prevent the institutions that are not yet decided to adopt from adopting PREMIS. Figure 26 lists five of the least frequently identified factors that discourage PREMIS adoption in cultural heritage institutions and Table 53 lists eight of the most frequently identified barriers.

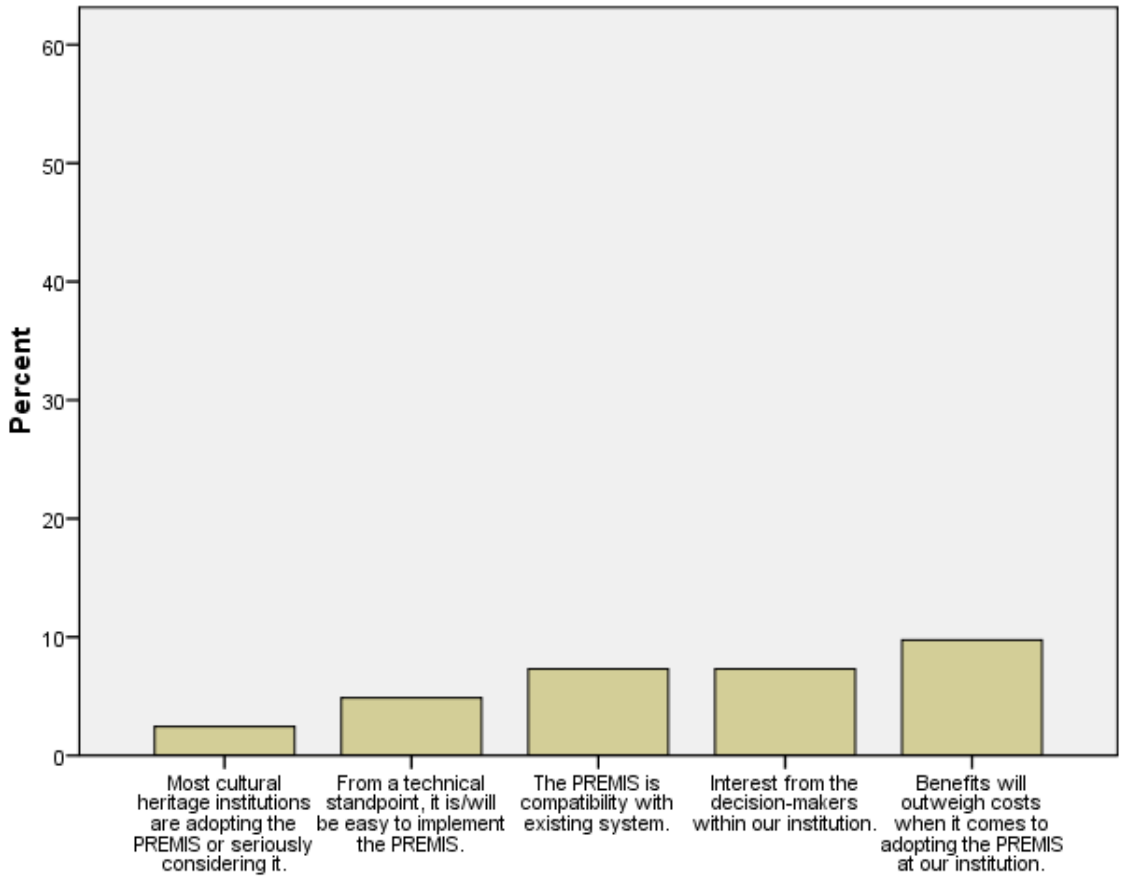

Figure 26. Five least-frequently identified factors that discourage PREMIS adoption by all respondents.

Table 53

Eight Most Frequently Identified Barriers or Factors that Discourage PREMIS Adoption by All Respondents

Factors		Frequency	Percent %
Lack of training/expertise.		26	48.1
Lack of integration or incompatibility with existing system		20	37.0
We lack the knowledge necessary to be confident in our ability to implement the PREMIS.		16	29.6
Lack of interest from the decision-makers within our institute.		13	24.1
Institutions that have adopted the PREMIS cannot provide evidence of its effectiveness.		11	20.4
Usability requirements are too high.		11	20.4
Our institution prefers to take a wait-and-see approach when it comes to adopting new system.		8	14.8
Our institution has limited capacity to absorb negative consequences that might occur as a result of implementing the PREMIS.		8	14.8

PREMIS 1.0 versus PREMIS 2.0

In March 2008 the PREMIS Editorial Committee issued a revised version of the PREMIS Data Dictionary. The fundamental data model of PREMIS or the event and relationship information have not changed. But, significant changes have been made in the XML schema in a way that can facilitate the mapping of the data dictionary's applicability and obligation constraints to the XML schema. One of the most important changes is the possibility of using extensions from within PREMIS that permit embedding of metadata from other metadata schemas. Some elements used in the AIPs could be refined within PREMIS using an additional metadata schema. The event outcome, as well as the creating application, the object characteristics, and the significant properties could be described in more detail. The changes, among other things, might improve and simplify the validation process (Lavoie, 2008; and PREMIS Editorial Committee, 2008).

Some respondents mentioned that they did not like the fact that they have to store identical information redundantly. For example, one respondent mentioned that "our institution captures rights information in MODS rather than PREMIS in order to keep it together with other descriptive information." Although, there are some overlaps, depending on the purpose, some of the metadata can be reused for several purposes. Technical information such as file format and file sizes, for example, are important for preservation purposes. Since most of these information are part of a detailed description of a digital document, and since PREMIS permits referencing an external format registry, they could be reused using those tools listed in Table 51 (Dappert & Enders, 2008).

Summary of Research Question-3

Like any other innovation, PREMIS is not a goal in itself, but an instrument for an institution to achieve its digital preservation (strategic) goals. As discussed in chapter 2, many researchers agree that innovation is simply converting knowledge into solutions that create distinctive value. However, as noted by Cotora (2007), converting knowledge into long-term business value is, in practice, a far more difficult process than in theory. And, in innovation adoption research it is generally assumed that the innovation, often a technological innovation, has stable, pre-determined features and is considered for adoption when the organization judges it to be beneficial to the business.

In this regard, a number of interview participants viewed PREMIS as an innovation that was not yet fully developed. This finding may have resulted in part from the dominant view of the majority (about 40%) of the cultural heritage institutions that are in the planning stage category.

Since the data collection was conducted before the release of PREMIS 2.0, most respondents, particularly from those institutions that were in the planning stage mentioned that they were eagerly awaiting a much-anticipated version 2.0. As one respondent put it: “We are ready [to adopt PREMIS], but we don’t want to adopt PREMIS 1.0, which can be changed anytime now.”

In March 2008 the PREMIS Editorial Committee issued a much-revised version of the PREMIS Data Dictionary. We attempted to contact some of the early adopters (during the analysis phase of this study, in summer 2008), but it was still too early to know the impact of the changes on their respective systems. As one respondent

summarized it “we hope that PREMIS 2.0 will address the concerns we have about the .PREMIS.” The next chapter offers further speculations on this and recommends further research.

Summary of Data Analysis

The lack of insight into preservation metadata adoption leads to the aforementioned three research questions. To answer these questions, the appropriate choice for a theoretical approach appears to be innovation adoption theory. In this line of research, a lot of knowledge has been gathered on conceptualizing innovation adoption, mechanisms of organizational innovation adoption behavior, and related institutional characteristics.

As summarized in Table 53 and Figure 27, the result of the analysis indicated that all identified factors affect PREMIS adoption in one way or another. All six factors were contributed in varying degree to the adoption of PREMIS by the individual participants and, hence, by their respective cultural heritage institutions.

Innovations that are perceived by potential adopters as having greater relative advantage, compatibility, trialability, observability, and less complexity will be adopted more rapidly than other innovations. A number of researchers note that groups are receptive to learning from others only during specific periods in the groups’ life cycle, with the beginning of that life cycle being a particularly receptive time (Argote, Beckman, & Epple, 1990; Baum & Ingram, 1998; Lee, 2005).

The understandings from this study and the study of other innovation adoptions lead to some recommendations for action for those interested in the more effective adoption of PREMISE in cultural heritage institutions. The next chapter provides recommendations and conclusion.

CHAPTER 5

SUMMARY AND CONCLUSIONS

Introduction

This chapter presents a summary of the research results. In chapter 1, the paper provided the general outline and purpose of the study by conceptually analyzing the theoretical framework. In chapter 2, further analysis and synthesis of literature on innovation adoption and digital preservations was presented to provide deeper understanding of the theoretical framework in light of adoption of preservation metadata in cultural heritage institutions. Based on the theoretical framework, chapter 3 dealt with methodology and a discussion of the operationalization of the data. Chapter 3 also explained the data analysis and the methodology. Chapter 4 provided the results of the data analysis; descriptive statistics and regression analysis were used to depict the results of the data-gathering and to investigate the relationships between variables. Finally, this chapter (chapter 5) provides a summary of the major findings and concludes the research study. This chapter also explains the importance of this research and its implications and makes recommendations for future studies.

Importance of the Research

The purpose of this study was to identify factors that affect PREMIS adoption in cultural heritage institutions using Rogers' (2003) diffusion of innovations theory. The

study employed Rogers' five attributes of innovations as well as one additional attribute to predict institutional factors, which are: relative advantage, compatibility, complexity, trialability, observability, and institutional readiness. This study enhances understanding of the factors that affect adoption of PREMIS in cultural heritage institutions and adoption of standards in general.

Answers to the Questions of the Study and Speculations in the Context of Rogers' DOI Model

This exploratory research study has three research questions: (a) what are the factors (i.e. attributes in the diffusion of innovations theory) that affect the adoption of PREMIS across the diverse cultural heritage institutions?, (b) what influence did PREMIS have on the decision to adopt preservation metadata schemes and on current practices of preservation metadata management in the cultural heritage institutions?, and (c) among the diverse cultural heritage institutions that adopted or plan to adopt PREMIS, are there commonalities in factors that may affect the decision-making process? Are there differences by type of institution?

In order to answer the three research questions, both qualitative and quantitative analysis were performed and the results presented. Analysis of the data revealed that all of the six factors influence the adoption of PREMIS, albeit in varying degrees. Results of the analysis of the combined variables regression analysis of adoption level on the six factors (Table 49, chapter 4) showed that adoption level has a statistically significant relationship with the six factors. The R square value for the model was .528, which means that 52.8% of the variance in PREMIS adoption was explained by the six

predictors together. Table 55 shows the average semi-partial squared values or the relative contributions of each predictor to the variance accounted for R square (R^2).

Table 54

Relative Contributions of Each Predictor to the Variance Accounted for R square (R^2)

Predictors	R^2	% of R^2
Trialability	0.187	35.5%
Institutional-Readiness	0.174	32.9%
Relative-Advantage	0.085	16.1%
Observability	0.034	6.5%
Complexity	0.025	4.7%
Compatibility	0.023	4.3%
Sum	.528	100%

Based on the average semi-partial squared values in Table 54, three predicators (trialability, institutional readiness, and relative advantage) are noticeable. As individual predictors, the trialability construct was the strongest predictor of PREMIS adoption, explaining 18.7% of the variance in predicting the PREMIS adoption. Institutional readiness was a close second, explaining 17.4% of the variance, and the relative advantage attribute was a distant third, explaining 8.5% of the variance in PREMIS adoption.

Similarly, the standardized coefficients values in Appendix F also confirms that, among the six variables, institutional readiness, trialability, and relative advantage were

the three best predictors of PREMIS adoption. Figure 27 provides summary of attributes that influence PREMIS adoption. The line strength in Figure 27 shows the level of influence.

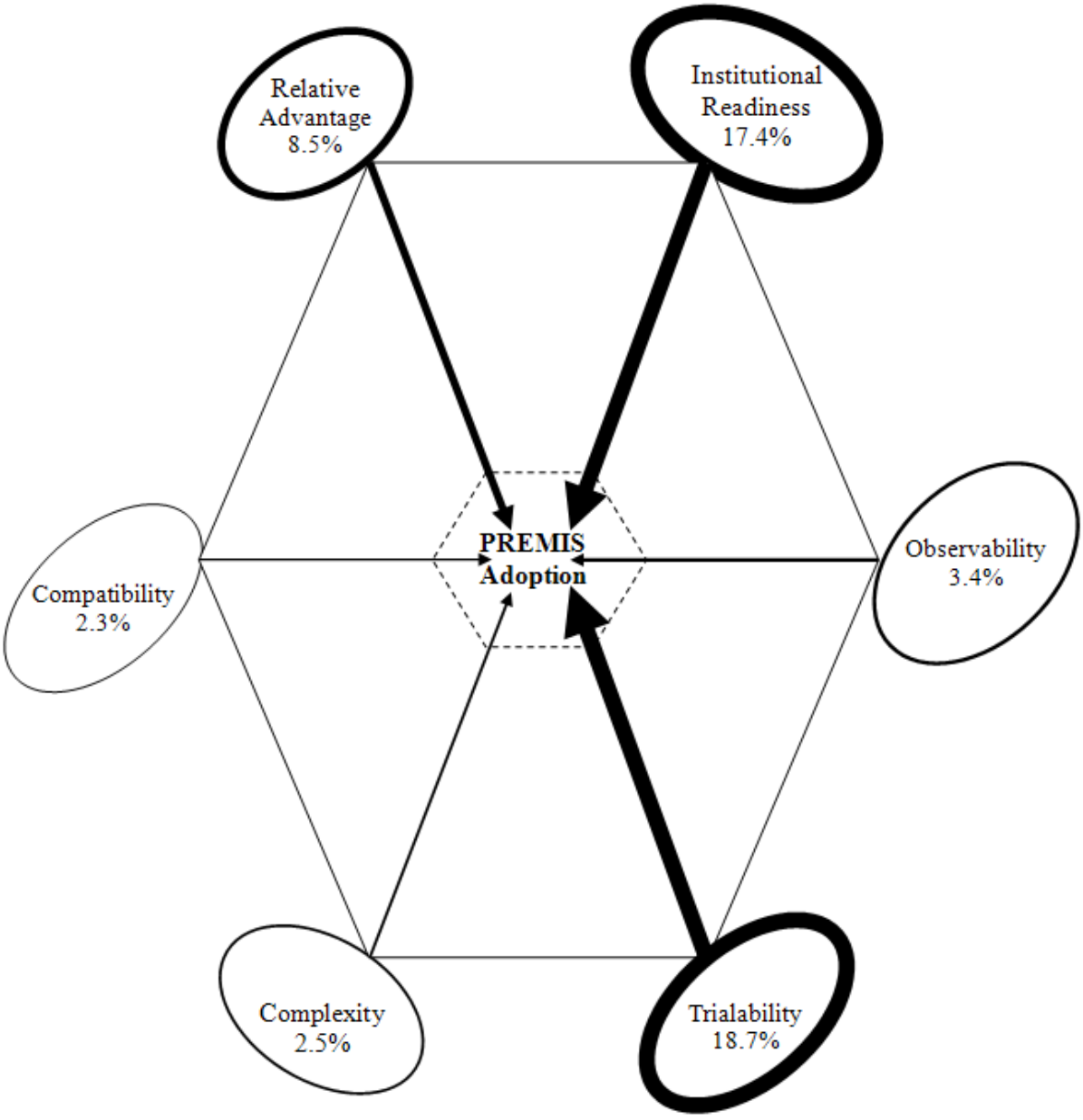

Figure 27. Summary of attributes that influence PREMIS adoption.

The data analysis revealed that a vast majority of the institutions had not yet reached the development stage in terms of their level of PREMIS adoption. Although academic institutions and national libraries were among the early adopters, the overall adoption was not that high. Out of the 123 participants who responded to the survey, only 4 institutions (fewer than 3% of the respondents) had fully adopted PREMIS. Even though there are some commonalities, there are notable differences among cultural heritage institutions. As discussed in chapter 4 of this document, this disparity in the adoption of PREMIS among diverse cultural heritage institutions can be attributed to the factors identified in the study.

Figure 28 depicts the PREMIS adoption stage category assignments as reported by the respondents, which tend toward a normal distribution. There is a strong resemblance with the innovation of adoption curve of Rogers that classifies adopters into five categories (innovators, early adopters, early majority, late majority, and laggards). The following section summarizes the PREMIS adoption stage in light of Rogers' (2003) five-phases of technology adoption life cycle model and helps understand some of the issues discussed in both chapters 2 and 4 and put the factors that influence PREMIS adoption in context.

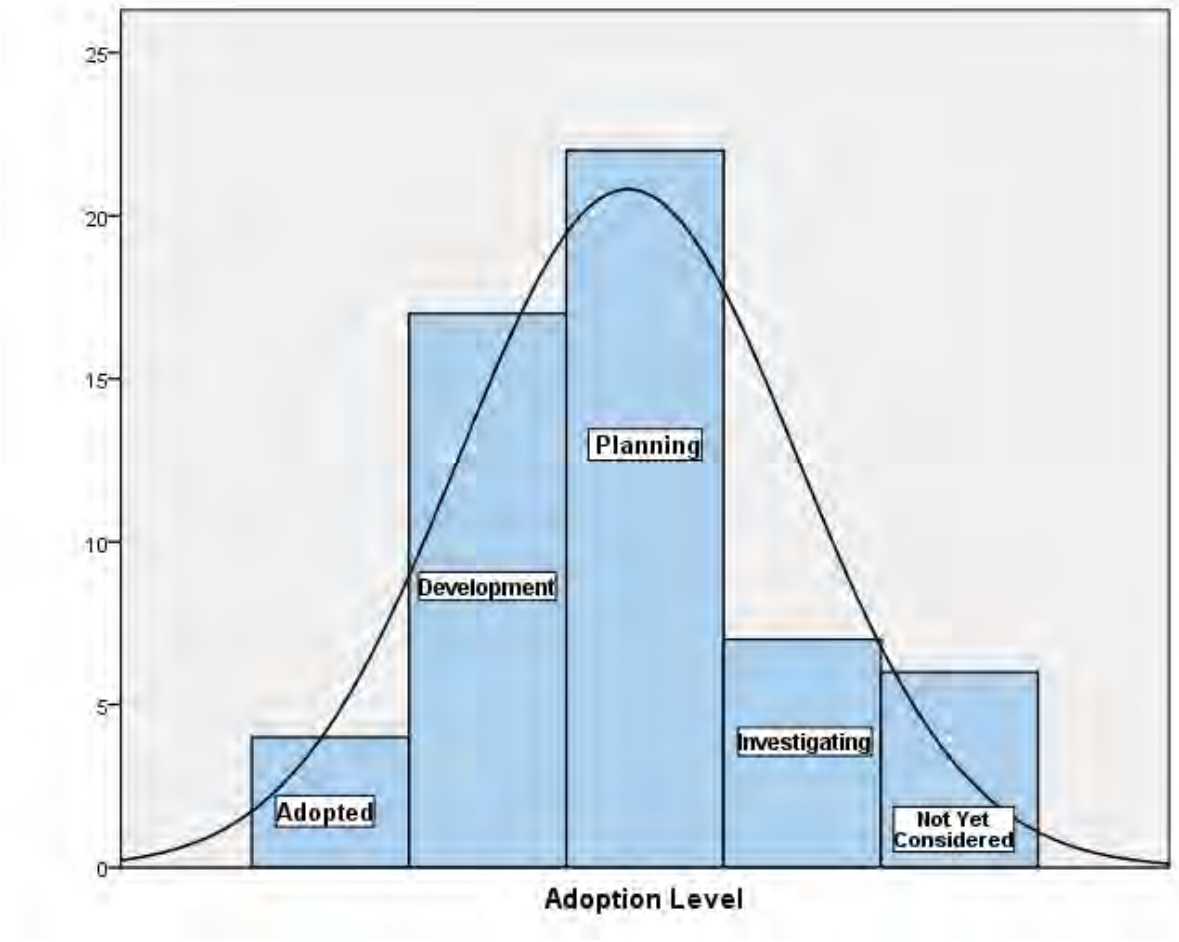

Figure 28. PREMIS adoption stages in cultural heritage institutions

Innovators and the "Fully Adopted" Stage

Innovators were creators of the new standards, and were involved in the standard organization during the *inception phase* of these standards. These are institutions that have prior experience with other related metadata standards or that have vested interests in digital preservation and promoting PREMIS as a standard or as viable solution to digital preservation challenges.

Early Adopters and the "Development (Alpha-Beta)" Stage

Early adopters had the vision to adopt an emerging standard because of preservation needs and possible prospects. In this phase, the supporting tools and procedures were not fully developed to support the PREMIS implementation. As a result, there were challenges in building digital preservation procedures using unstable metadata standards.

Early Majority and the "Planning" Stage

The early majority preferred to stay away from cutting edge technologies to avoid the risk associated with emerging standards. But, as reported in previous research studies (Chen, 2003), this hypergrowth phase (as depicted by the increased slope in Figure 28) has the highest adoption rate due to network externality effect. Many cultural heritage institutions belong to this category. This is the beginning of a mass adoption for a successful innovation; if benefits are demonstrated by the early adopters, cultural heritage institutions that are in planning stages will be quick to adopt PREMIS.

Late Majority and the "Investigative" Stage

The late majority represent those potential adopters who dislike discontinuous innovations. They believe in traditional technologies rather than emerging ones. Cultural heritage institutions in this investigative stage adopt PREMIS standards mainly because their major funders or collaborators require them to use the same standards. Most museums and other institutions (including small libraries) that do not have adequate

resources often belong to this category. Usually, this group adopts when the standard has entered the stage of maturity.

Laggarts and the "Not Yet Considered" Stage

Laggarts (traditionalists) do not engage with standards or new technology products. They may not have all of the ingredients required for the institutional readiness to adopt PREMIS successfully. When they are ready for these standards, newer standards may have been developed to replace existing ones this is when the technology has entered the decline phase (Rogers, 2003).

Institutional Differences

Institutional readiness has been considered as a factor and studied to determine its influence on PREMIS adoption in cultural heritage institutions. More and more cultural heritage institutions including archives, museums, and libraries are actively participating in digital preservation metadata and related standardization efforts and are incorporating these standards in their local tools and environments.

Data from the study suggests that the PREMIS is a new innovation and its adoption, as it is currently being carried out, is likely to improve coverage. Some funding agencies, such as IMLS, NEH, etc are encouraging grant applicants to comply with PREMIS standards and most national libraries and some academic institutions proactively chose to build their digital information infrastructures using standards that allowed them to achieve seamless integration and to gain higher interoperability.

Impact of Assumptions and Limitations

The findings of this study indicate that PREMIS has not reached its full potential as a digital preservation metadata standard across diverse cultural heritage institutions. PREMIS is new and in the early stage of innovation, so growth is relatively slow as the innovation establishes itself.

Given the wide range of responses, generalization of the findings from an institutional perspective are difficult to make. For example, many respondents stated that because PREMIS is still changing and because they see little success story, they wouldn't be adopting PREMIS in the near future.

The data collection for this study was conducted before the release of the new version of the PREMIS. Although the data shows a reluctance to adopt a preservation metadata that is in revision, it is the nature of developing standards to continually revise. In other words, there is no good timing. As shown in this study, most of the national libraries and academic institutions are the innovators and earlier adopters in PREMIS adoption. The more institutions that adopt a standard, the faster it will be adopted by the general population due to the network externality effect.

Suggestions for Further Reflection and Research

This study primarily focused on identifying factors that affect (facilitate or hamper) PREMIS adoption from cultural heritage institutions' perspectives. From a preservation metadata adoption perspective, the findings of the study revealed that the innovation characteristics and institutional readiness attributes were statistically significant predictors of the adoption of PREMIS by cultural heritage institutions. To

foster individual acceptance of a newly-adopted or implemented technology, stakeholders and decision makers in cultural heritage institutions need to devise strategies for cultivating positive attitudes toward using the PREMIS.

In this regard, favorable perception of the PREMIS' usefulness is one of the positive factors, whereas the PREMIS' ease of use might not be of equal importance. Upon deciding to adopt PREMIS, decision makers should strongly emphasize, demonstrate, and communicate the PREMIS' usefulness versus the preservation challenges to those who are undecided. The PREMIS maintenance group should focus more on training programs and on communicating how the PREMIS can improve the efficiency or effectiveness of any preservation procedure rather than on familiarization with the elements and parts.

All stakeholders should identify other barriers that prevent undecided institutions from deciding and adopting (and crossing the chasm) and then deploy tools and strategies to reduce the traction for PREMIS adoption.

Future studies need to examine and empirically test the relationships, for example, between and among the institutional readiness characteristics, to provide a deeper understanding of institutional characteristics that explain preservation metadata adoption in cultural heritage institutions.

Future researchers may need to ascertain the results of this study through factor analysis. In order to do so, a far larger sample size is required. Factor analysis can be only as good as the data allows, and future researchers may need to contact more cultural heritage institutions and focus even more on the specific type of institutions (within the cultural heritage community), to investigate their differences.

Training is one of the most important factors and more emphasis is needed in this area. Cultural heritage institutions need to have common understanding of what is really meant by PREMIS conformance. This would ensure that all have acceptable level of common understanding regarding PREMIS compliance as well.

Some institutions that participated in this study clearly believed that adopting PREMIS was well worth the effort. However, a number of institutions stated that they wouldn't be adopting PREMIS in the near future because insufficient resources were allocated to adopt PREMIS, and because they see little return on investment. In this regard, additional studies into why there are such vast differences in perceptions of costs and benefits would be informative.

If the benefits of PREMIS are demonstrated by the early adopters, the vast majority of cultural heritage institutions that are in the planning stage now (Figure 27) will be ready to adopt PREMIS. However, if they are not convinced, there could be discontinuity, or what Moore (1991) called the *chasm*, which is the time gap in the technology adoption life cycle, (between the traction phase and hypergrowth phase). As can be seen from Figure 29, there is a potential risk of witnessing a chasm. To avoid the chasm and facilitate continuous PREMIS adoption, this study gives some pointers to all stakeholders (including the PREMIS editorial board, cultural heritage institutions that adopt PREMIS, and, of course, future researchers).

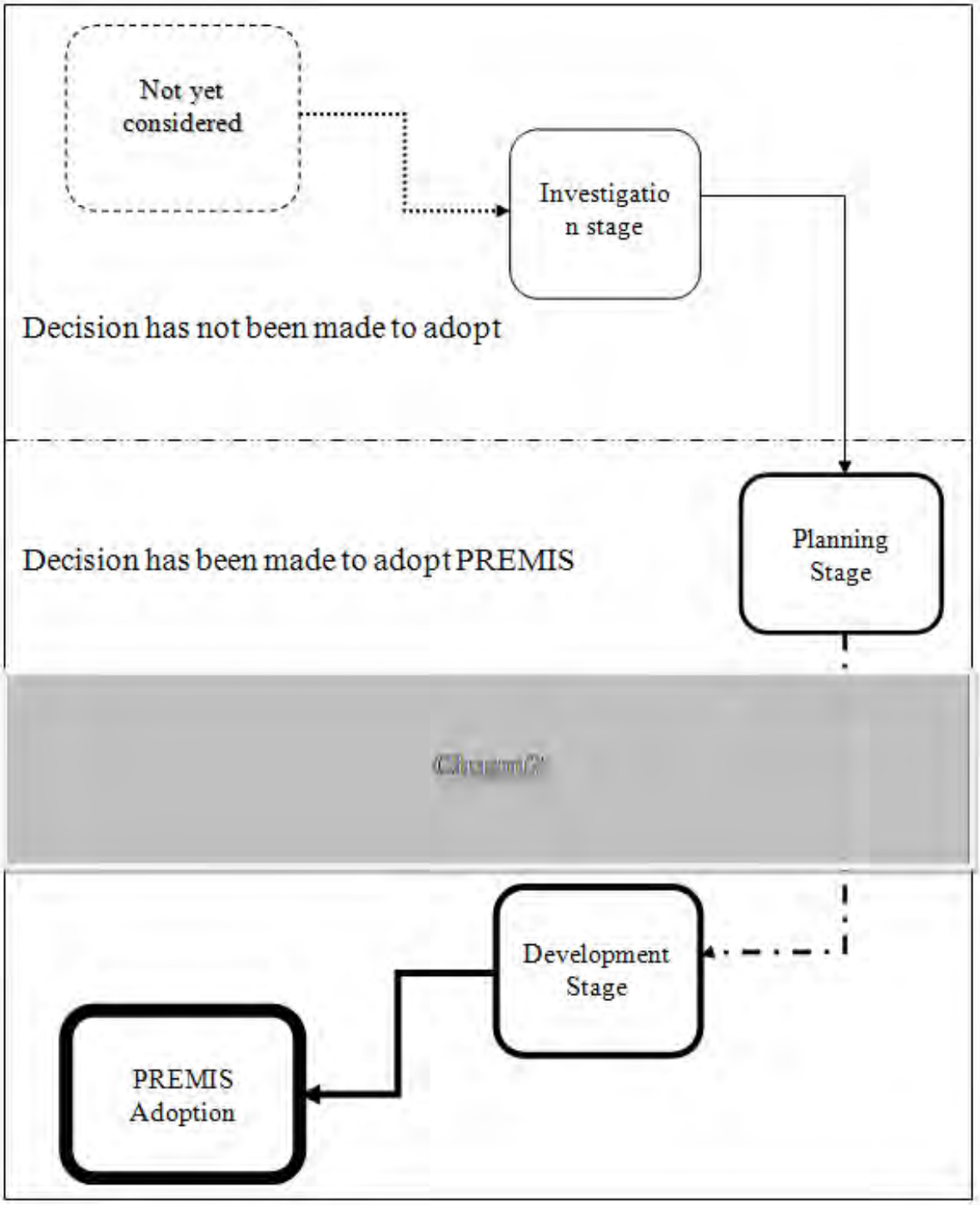

Figure 29. Identifying the chasm (if any).

Conclusion

This exploratory study identified and explained factors that affect PREMIS adoption. If each of the factors identified in this study are considered and addressed, they can influence the rate of adoption. Based on the findings in this study, it can be concluded that investigating the adoption of PREMIS in cultural heritage institutions is important. Due to the lack of research in preservation metadata adoption there is much room for additional research to be conducted.

PREMIS is a relatively new innovation and research on this topic is valuable, not only for current adopters, but also for potential adopters who are considering the opportunities and benefits PREMIS may allow them in tackling the digital projects issues. This research has demonstrated that the identification of factors influencing the adoption decisions of cultural heritage institutions is also a topic that is worth pursuing. Cultural heritage institutions have stages of adoption that map to the factors or variables seen in other innovation adoption studies.

Indications are that there is a pattern that supports the theoretical construct developed from Rogers' original work. As discussed in chapter 2, literature on diffusion of innovations suggests that time could be a vital factor in adoption of the PREMIS. Rogers (2003) defined five main steps in an innovation-decision process: learning of an innovation's existence and some of its functions (knowledge); forming a favorable or unfavorable attitude toward it (persuasion); engaging in activities that lead to an adopt/reject choice (decision); putting the innovation into use (implementation); and seeking information that reinforces or refutes the innovation-decision (confirmation).

Of most importance to this study is that the continuous process and cycle of adoption may be the same for any set of standards. However, this is merely one of the first studies in this area and it should be considered as an initial way of thinking about and approaching the issues. From the results of this exploratory study, it is clear that much remains to be illuminated in light of the multi-faceted issue of adopting preservation metadata and the diverse needs of cultural heritage institutions.

Studying adoption of innovations requires a longitudinal study to understand an inherently complex set of issues that affect adoption. These understandings lead to some recommendations for action for future researchers and in this case, of course, for those interested in the more effective adoption of preservation metadata in cultural heritage institutions. Stakeholders in the context of PREMIS adoption are all possible individuals, institutions, or organizations who have influence over or may be impacted by the adoption of PREMIS in cultural heritage institutions.

The next steps beyond these are unpredictable at this point. Further developments in digital technologies are likely to produce new digital preservation challenges as well as opportunities. Essentially more studies (such as the aforementioned ones) highlight a number of ways in which PREMIS can become more effective and have a greater impact in cultural heritage institutions.

The theoretical framework selected for this research (DOI) has been identified as a suitable framework for further research in this topic area. By combining DOI with a number of other existing theories, further research in this domain will increase understanding and also clarify and expand several approaches to investigating digital

preservation metadata in general. By doing so, PREMIS can be better poised to deal with the current and future needs of the wider cultural heritage community.

APPENDIX A

DETAILED TIMELINE OF THE PREMIS

Table-55

Detailed Timeline of the PREMIS

Date	Events/Activities	Description
Fall 2008	Continuous maintenance activities. (For further information about PREMIS current maintenance activities, see the PREMIS home page at: http://www.loc.gov/standards/premis/).	- Guidelines for using PREMIS with METS, - PREMIS Implementers' Registry, and - PREMIS Tutorials (Previous Tutorials include: Glasgow, Boston, Stockholm, Albuquerque, Washington, and California).
July/ August 2008	Rebecca Guenther, published: "Battle of the Buzzwords: Flexibility vs. Interoperability When Implementing PREMIS with METS"	This article, published in DLib Magazine, attempts to clarify some of the ambiguities in using PREMIS with METS and solicits comments for the upcoming (PREMIS in METS) guidelines.
May/June 2008	Brian Lavoie published an article entitled: "PREMIS with a Fresh Coat of Paint: Highlights from the Revision of the PREMIS Data Dictionary for Preservation Metadata."	The article (in DLib Magazine, May/June 2008 issue) describes the revision process and its outcomes, including a summary of the major changes appearing in the new version of the PREMIS Data Dictionary.
April 2008	The PREMIS Editorial Committee released the revised data dictionary (version 2.0).	Incorporated numerous changes to version 1.0, based on extensive discussions with implementers the suggestions made by early adopters and other participants in the review process.

(table continues)

Table-55 *(continued)*

Date	Events/Activities	Description
June 2007	Deborah Woodyard-Robinson published report on: *Implementing the PREMIS Data Dictionary: a Survey of Approaches*	The Library of Congress, as part of the PREMIS maintenance activity, commissioned Deborah Woodyard-Robinson to explore how institutions have implemented the PREMIS semantic units. In this study 16 repositories were surveyed about their interpretation and application of the PREMIS Data Dictionary (PDD).
[May] 2007	PREMIS was endorsed as a METS extension schema.	PREMIS schemas endorsed by the METS Editorial Board for use with METS.
December 2006	Karen Coyle published a report entitled: "Rights in the PREMIS Data Model."	In this 32-page report, Karen Coyle reviews the landscape of digital rights and analyzes various preservation rights scenarios.
August 2006	The PREMIS Editorial Committee was formed to coordinate and approve future revisions of the Data Dictionary and XML schema.	The ten-person Editorial Committee members are experts from a variety of institutions and countries, (chaired by Rebecca Guenther of the Library of Congress).
August 2006	PREMIS won the 2006 Society of American Archivists' Preservation Publication Award.	For "writing of superior excellence and usefulness, which advances the theory or practices of preservation in archival institutions."
November 2005	The PREMIS working group won the 2005 British Conservation Award: Digital Preservation Award.	The DPC-sponsored £5,000 Digital Preservation Award for "leadership and advancement in digital preservation which will benefit the UK."

(table continues)

Table-55 *(continued)*

Date	Events/Activities	Description
May 2005	PREMIS published the final report entitled: *Data Dictionary for Preservation Metadata: Final report of the PREMIS Working Group*	PREMIS completed its activities in May 2005 with the release of the final 237-page report. Includes: Data Dictionary 1.0; data model, context/assumptions, and usage examples.
September 2004	PREMIS published its first major report entitled: *Implementing Preservation Repositories for Digital Materials: Current Practice and Emerging Trends in the Cultural Heritage Community*	Survey got 49 responses (28 libraries, 7 archives, 3 museums, and 11 others, from 13 countries). It provided snapshot of current practice and emerging trends related to managing and using preservation metadata to support preservation activities: 38% in planning; 33% development; 46% in production stages.
June 2003	A second working group - PREMIS - was formed to address implementation issues.	OCLC/RLG sponsored new international working group: PREMIS: **Pre**servation **M**etadata **I**mplementation **S**trategies.
June 2002	Publication of: *A Metadata Framework to Support the Preservation of Digital Objects*	It is a comprehensive high-level description of the types of information falling within the scope of preservation metadata. Used OAIS reference model as starting point.
January 2001	Publication of: *Preservation Metadata for Digital Objects: A Review of the State of the Art*	A white paper by OCLC/RLG Working Group on Preservation Metadata.

(table continues)

Table-55 *(continued)*

Date	Events/Activities	Description
2001-2002	OCLC and RLG convened an international working group of experts.	The main goal was to develop a metadata framework to support the long-term retention of digital materials.
March 2000	OCLC and RLG announced their commitment to collaborate on identifying and supporting best practices for the long-term retention of digital objects.	A major focus of this cooperation was to promote consensus in best practices for the use of metadata to support of digital preservation processes.

APPENDIX B

INSTITUTIONAL REVIEW BOARD (IRB) PERMISSION LETTERES

UNT
UNIVERSITY OF
NORTH TEXAS
DISCOVER THE POWER OF IDEAS

OFFICE OF THE VICE PRESIDENT FOR RESEARCH
Office of Research Services

November 26, 2007

Daniel Alemneh
School of Library and Information Sciences
University of North Texas

Re: Human Subjects Application No. 07-450

Dear Mr. Alemneh:

As permitted by federal law and regulations governing the use of human subjects in research projects (45 CFR 46), the UNT Institutional Review Board has reviewed your proposed project titled "An Examination of the Extent of Adoption of Preservation Metadata in Cultural Heritage Institutions: An Exploratory Study Using Diffusion of Innovation Theory." The risks inherent in this research are minimal, and the potential benefits to the subject outweigh those risks. The submitted protocol is hereby approved for the use of human subjects in this study. **Federal Policy 45 CFR 46.109(e) stipulates that IRB approval is for one year only, November 26, 2007 to November 25, 2008.**

Enclosed is the consent document with stamped IRB approval. Please copy and **use this form only** for your study subjects.

It is your responsibility according to U.S. Department of Health and Human Services regulations to submit annual and terminal progress reports to the IRB for this project. Please mark your calendar accordingly. The IRB must also review this project prior to any modifications.

Please contact Shelia Bourns, Research Compliance Administrator, or Boyd Herndon, Director of Research Compliance, at extension 3940, if you wish to make changes or need additional information.

Sincerely,

Kenneth W. Sewell, Ph.D.
Chair
Institutional Review Board

KS:sb
CC: Dr. Brian O'Connor

P.O. Box 305250 | Denton, Texas 76203-5250 | TEL 940.565.3940 | FAX 940.565.4277 | TTY 940.369.8652 | www.unt.edu

University of North Texas Institutional Review Board

Informed Consent Notice (for Survey)

Thank you for your interest in participating in the research. Before agreeing to participate in this research study, it is important that you read and understand the following explanation of the purpose and benefits of the study and how it will be conducted.

Title of Study: An Examination of the Extent of Adoption of Preservation Metadata in Cultural Heritage Institutions: An Exploratory Study Using Diffusion of Innovation Theory

Principal Investigator: Daniel Gelaw Alemneh, a doctoral candidate in the University of North Texas (UNT) School of Library and Information Sciences.

Purpose of the Study: You are being asked to participate in a research study which involves answering a survey that is designed to identify factors that may affect Preservation Metadata Implementation Strategies (PREMIS) adoption in cultural heritage institutions.

Study Procedures: The research involves completing a survey that asks you to indicate your level of agreement or disagreement with statements relating to factors that may affect PREMIS adoption. The survey will take about fifteen minutes of your time. You must be 18 years of age or older to participate in this study. You give your voluntary consent by completing the survey. Participation is voluntary and you may stop at any time.

Foreseeable Risks: No foreseeable risks are involved in this study.

Benefits to the Subjects or Others: This study is not expected to be of any direct benefit to you. However, this study may benefit your institution and cultural heritage community at large in future in making more conscious decisions regarding adoption of preservation metadata in general. In particular, we hope to learn more about factors affecting adoption of PREMIS, using diffusion of innovation as a theoretical framework. Results of this study will be made available to all participants through a web site.

Procedures for Maintaining Confidentiality of Research Records: The survey is anonymous. At no time will you be identified by name or by any other identifying information. Data will be aggregated, or automatically combined, by computer. No individual survey responses will be reported. Information will be kept confidential, including in any publications or presentations regarding this study. The survey files will be kept on a password-protected computer and all the files will be permanently deleted after three years.

Questions about the Study: If you have any questions regarding this study, you may contact Daniel Gelaw Alemneh at telephone number 940-891-6746 or email at Dalemneh@library.unt.edu or Dr. Samantha Hastings, University of South Carolina, at: 803-777-3858 or Dr. Brian O'Connor, UNT School of Library and Information Sciences at 940-565-2445.

Review for the Protection of Participants: This research study has been reviewed and approved by the UNT Institutional Review Board (IRB). The UNT IRB can be contacted at (940) 565-3940 with any questions regarding your rights as a research participant. You may print this notice for your records.

Thank you again very much for your participation!

APPROVED BY THE UNT IRB
FROM 11/26/07 TO 11/25/08

Daniel Gelaw Alemneh
Doctoral Candidate, University of North Texas School of Library and Information Sciences

Email: Dalemneh@library.unt.edu
Tel. (940) 369-7809
Fax: (940) 565-2599

University of North Texas Institutional Review Board

Informed Consent Notice (for Telephone Interviews)

Before agreeing to participate in this research study, it is important that you read (or have had read to you) and understand the following explanation of the purpose and benefits of the study and how it will be conducted.

Title of Study: An Examination of the Extent of Adoption of Preservation Metadata in Cultural Heritage Institutions: An Exploratory Study Using Diffusion of Innovation Theory

Principal Investigator: Daniel Gelaw Alemneh, a doctoral candidate in the University of North Texas (UNT) School of Library and Information Sciences

Purpose of the Study: You are being asked to participate in a research study which involves identifying and understanding factors that may affect Preservation Metadata Implementation Strategies (PREMIS) adoption in cultural heritage institutions.

Study Procedures: You will participate in an interview that will take ten to fifteen minutes of your time. Interview records in digital format and your information will be kept on the password-protected computer in my office during the study. The files will be deleted permanently upon completion of the study.

***Foreseeable Risks*:** No foreseeable risks are involved in this study.

***Benefits to the Subjects or Others*:** This study is not expected to be of any direct benefit to you. However, this study may benefit you, your institution, and cultural heritage community at large in future in making more conscious decisions regarding adoption of preservation metadata in general. In particular, we hope to learn more about factors affecting adoption of PREMIS, using diffusion of innovation as a theoretical framework.

Procedures for Maintaining Confidentiality of Research Records: The audio files will be kept digitally together with the survey files on a password-protected computer for 3 years past the end of the study. Then the files will be deleted permanently. You can be provided with a copy of the interview transcript. The confidentiality of your individual information will be maintained in any publications or presentations regarding this study.

Questions about the Study: If you have any questions about the study, you may contact Daniel Gelaw Alemneh at telephone number 940-891-6746 or email at Dalemneh@library.unt.edu or Dr. Samantha Hastings, University of South Carolina, at: 803-777-3858 or Dr. Brian O'Connor, UNT School of Library and Information Sciences at 940-565-2445.

Review for the Protection of Participants: This research study has been reviewed and approved by the UNT Institutional Review Board (IRB). The UNT IRB can be contacted at (940) 565-3940 with any questions regarding the rights of research subjects.

Research Participants' Rights: You have read or have had read to you all of the above. Daniel Gelaw Alemneh has explained the study to you and answered all of your questions. You understand that you do not have to take part in this study, and your refusal to participate or your decision to withdraw will involve no penalty or loss of rights or benefits. The study personnel may choose to stop your participation at any time.

Thank you for helping with this study to identify factors and gain a broad understanding of issues that may affect PREMIS adoption.

Daniel Gelaw Alemneh
[redacted]University of North Texas School of Library and Information Sciences
Denton, TX 76203
Tel. (940) 369-7809
Fax: (940) 565-2599
Email: Dalemneh@library.unt.edu

APPROVED BY THE UNT IRB
FROM 11/26/07 TO 11/25/08

APPENDIX C

SURVEY QUESTIONNAIRE AND CALL FOR PARTICIPATION

Call for Survey Participation: Adoption of Preservation Metadata

Dear Colleague,

We would like to invite you to participate in a research study whose main goal is to identify and understand factors affecting adoption of PREservation Metadata Implementation Strategies (PREMIS) in cultural heritage institutions. The online survey questionnaire contains 18 questions
and would take about 15 minutes to complete.

You will be asked to indicate various factors and rate the importance of each factor and the role it played in influencing your decision-making processes. Your co-operation in providing the information will be invaluable in ensuring a true picture is formed. Your response will be recorded anonymously and findings will be summarized in aggregated form to protect the identity of participating individuals and institutions.

If your institution has implemented (or plans to implement) PREMIS, we specifically encourage you to participate in the study. Results of this study may benefit cultural heritage institutions in making more conscious decisions regarding adoption of preservation metadata in general. To
participate in this online survey please go to:
http://www.surveymonkey.com/s.aspx?sm=uehwFW92JN5NXfhpwFC8Cw_3d_3d

Please feel free to forward this to colleagues you think might be interested. Should you have any questions or desire further information, please contact Daniel Gelaw Alemneh at: dalemneh at library.unt.edu.

Thanks in advance for your participation. Your response is highly valued and appreciated.

Daniel Gelaw Alemneh
Doctoral Candidate, University of North Texas

Spanish Version of Call for Survey Participation

Solicitud para participar en una encuesta: Adopción de Metadata para la Preservación de Información

Estimado colega:

Me es grato invitarle a participar en un estudio de investigación afectan la adopción de estrategias de implementación de Metadata para la Preservación de Información (PREservation Metadata Implementation Strategies, "PREMIS") en instituciones culturales (Museos, Bibliotecas, Universidades, etc.). El cuestionario de encuesta, cuyo acceso es vía de Internet, contiene 18 preguntas y toma alrededor de 15 minutos responderlo.

Se le pregunta su opinión sobre diferentes factores, valorar la importancia de cada uno de ellos, y el papel que juegan en los procesos de toma de decisiones en relación con Meta data para la preservación de información. Su ayuda al proporcionar dicha información será inestimable para garantizar resultados confiables. Su participación será anónima y los resultados serán compilados de forma tal que participación de individuos e instituciones será salvaguardada.

Si su institución ha implementado o pretende establecer PREMIS (estrategias de implementación de Meta data para la Preservación de Información), le agradecería que participara en el estudio. Los resultados de este estudio pueden beneficiar instituciones culturales (Museos, Bibliotecas, Universidades, etc.) en la toma de decisiones en cuanto a adopción de conservación meta data en general. Para participar en esta encuesta por favor vaya a la siguiente dirección de Internet:

http://www.surveymonkey.com/s.aspx?sm=uehwFW92JN5NXfhpwFC8Cw_3d_3d

Por favor re-envié este email a colegas pudieran estar interesados. En caso de duda o si usted desea información adicional. Por favor contacte con Daniel Gelaw Alemneh a: dalemneh@library.unt.edu.

De antemano le agradezco. Su respuesta es muy apreciada y necesaria.

Atentamente

Daniel Gelaw Alemneh
Doctoral Candidate, University of North Texas
School of Library and Information Sciences

(*Translated by Dr. Miguel Arroyo Morales*)

1. Introduction

Thank you for your interest in participating in the research. The purpose of this study is to identify factors that may affect adoption of Preservation Metadata (specifically PREMIS) in the Cultural Heritage Institutions.

This survey contains 18 questions and should not take more than 15 minutes. This research study has been reviewed and approved by the University of North Texas (UNT) Institutional Review Board (IRB). Click "Next" to read the "Informed Consent Notice" If you'd like to leave the survey at any time, just click "Exit this survey".

Thank you for helping with this study to identify factors and gain a broad understanding of issues that may affect PREMIS adoption.

Daniel Gelaw Alemneh
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Denton, TX 76203-5190
Tel. (940) 369-7809
Fax: (940) 565-2599
Email: Dalemneh@library.unt.edu

2. Informed Consent Notice

Thank you for your interest in participating in the research. Before agreeing to participate in this research study, it is important that you read and understand the following explanation of the purpose and benefits of the study and how it will be conducted.

Title of Study: An Examination of the Extent of Adoption of Preservation Metadata in Cultural Heritage Institutions: An Exploratory Study Using Diffusion of Innovation Theory.
Principal Investigator: Daniel Gelaw Alemneh, a doctoral candidate in the University of North Texas (UNT) School of Library and Information Sciences.
Purpose of the Study: You are being asked to participate in a research study which involves answering a survey that is designed to identify factors that may affect Preservation Metadata Implementation Strategies (PREMIS) adoption in cultural heritage institutions.
Study Procedures: The research involves completing a survey that asks you to indicate your level of agreement or disagreement with statements relating to factors that may affect PREMIS adoption. The survey will take about fifteen minutes of your time. You must be 18 years of age or older to participate in this study. You give your voluntary consent by completing the survey. Participation is voluntary and you may stop at any time.
Foreseeable Risks: No foreseeable risks are involved in this study.
Benefits to the Subjects or Others: This study is not expected to be of any direct benefit to you. However, this study may benefit your institution and cultural heritage community at large in future in making more conscious decisions regarding adoption of preservation metadata in general. In particular, we hope to learn more about factors affecting adoption of PREMIS, using diffusion of innovation as a theoretical framework. Results of this study will be made available to all participants through a web site.
Procedures for Maintaining Confidentiality of Research Records: The survey is anonymous. At no time will you be identified by name or by any other identifying information. Data will be aggregated, or automatically combined, by computer. No individual survey responses will be reported. Information will be kept confidential, including in any publications or presentations regarding this study. The survey files will be kept on a password-protected computer and all the files will be permanently deleted after three years.
Questions about the Study: If you have any questions regarding this study, you may contact Daniel Gelaw Alemneh at telephone number 940-891-6746 or email at Dalemneh@library.unt.edu or Dr. Samantha Hastings, University of South Carolina, at: 803-777-3858 or Dr. Brian O'Connor, UNT School of Library and Information Sciences at 940-565-2445.
Review for the Protection of Participants: This research study has been reviewed and approved by the UNT Institutional Review Board (IRB). The UNT IRB can be contacted at (940) 565-3940 with any questions regarding your rights as a research participant. You may print this notice for your records.

Thank you again very much for your participation!

Daniel Gelaw Alemneh
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Email: Dalemneh@library.unt.edu
Tel. (940) 369-7809
Fax: (940) 565-2599

3. Part-I: Demographic information

1. With which institution are you affiliated?

2. Where are you located?

- ◯ United States
- ◯ Other Country

3. Your institution is best described as:

- ◯ Higher institution (University/college)
- ◯ Governmental research institute
- ◯ Non-governmental research institute
- ◯ National Library
- ◯ Archive
- ◯ Museum
- ◯ Digital documents producer (publishers, broadcasting, etc.)
- ◯ Other (please specify)

4. Which of the following best describes your current employment situation/position?

- ◯ Librarian
- ◯ Metadata Specialist
- ◯ Archivist
- ◯ IT staff
- ◯ IS management
- ◯ General management
- ◯ General staff
- ◯ Programmer
- ◯ Consultant
- ◯ Other (please specify)

5. Highest level of education attained

- [ ] Doctoral Degree
- [ ] Master's Degree
- [ ] Bachelor's Degree
- [ ] Some college
- [ ] Other (please specify)

4. Part II Institutional Preservation Activities

6. Which software packages or content management solutions are used for managing your institution's digital assets? Please check all that apply:

- [ ] ARNO
- [ ] CDSWare
- [ ] DIVA
- [ ] DSpace
- [ ] EDT
- [ ] Fedora
- [ ] GNU Eprints
- [ ] iTOR
- [ ] OPUS
- [ ] Locally developed system
- [ ] Other (please specify)

7. Which metadata schemes and best community practices are followed with your institution's digital repository? Please check all that apply:

- [ ] Audio Technical Metadata (AUDIOMD)
- [ ] CURL Exemplars in Digital ARchiveS (CEDARS)
- [ ] Creative commons metadata
- [ ] Dublin Core (DC)
- [ ] Metadata Encoding and Transmission Standard (METS)
- [ ] Networked European Deposit Library (NEDLIB)
- [ ] National library of Australia
- [ ] National library of New Zealand
- [ ] OCLC Digital archive metadata
- [ ] Online Information Exchange (ONIX)
- [ ] Reference Model for an Open Archival Information System (OAIS)
- [ ] Schema for rights declaration
- [ ] Standard from the Moving Picture Experts Group (MPEG21)
- [ ] Technical Metadata for Digital Still Images (MIX or Z39.87)
- [ ] Text Technical Metadata (TEXTMD)
- [ ] Victorian Electronic Records Strategy (VERS)
- [ ] Video Technical Metadata (VIDEOMD)
- [ ] Other (please specify)

8. How are the digital projects and related activities funded? Please check all that apply:

- [ ] Grant funded externally
- [ ] Grant funded internally
- [ ] Fee for service
- [ ] Part of institution's operational budget
- [ ] Other (please elaborate)

5. PREMIS Data Dictionary

9. The aim of PREMIS is to provide guidance on the "core" metadata needed to support digital preservation. Please rate the following parts of the PREMIS entities in terms of importance for your institution's preservation requirements:

	Very High	High	Medium	Low	Very Low	Don't Know
I. Object entity	◯	◯	◯	◯	◯	◯
II. Event entity	◯	◯	◯	◯	◯	◯
III. Agent entity	◯	◯	◯	◯	◯	◯
IV. Rights entity	◯	◯	◯	◯	◯	◯

10. The following are some of the features of the PREMIS data dictionary. Please assess the importance of the following features in terms of supporting digital preservations and related activities:

	Very Important	Important	Somewhat Important	Not Important	Not Very Important	Don't know
Data entry templates	◯	◯	◯	◯	◯	◯
Increased multi-lingual support	◯	◯	◯	◯	◯	◯
Quality assurance tools and mechanisms	◯	◯	◯	◯	◯	◯
Increased Export Functionality	◯	◯	◯	◯	◯	◯
Other	◯	◯	◯	◯	◯	◯

(please specify)

11. Do you use other externally available (or locally developed) tools for preservation metadata generation and/or extraction of technical metadata?

	Yes	No	I don't know
The JSTORE/Harvard Object Validation Environment (JHOVE)	◯	◯	◯
Digital Record Object Identification (DROID)	◯	◯	◯
National Library of New Zealand (NLNZ) Metadata Extraction Tool	◯	◯	◯
Global Digital Format Registry (GDFR)	◯	◯	◯
XML Electronic Normalizing of Archives (NOID)	◯	◯	◯
Other	◯	◯	◯

(please specify)

6. Factors influencing PREMIS adoption

The main goal of the current research project is to identify factors that may affect PREMIS adoption. This section focuses on identifying the most important stimulants and inhibitors.

12. How do you characterized the state of PREMIS adoption at your institution?

- ◯ Planning stage
- ◯ Development (alpha beta) stage
- ◯ Fully adopted
- ◯ Other (please specify)

13. Please indicate the extent to which you agree or disagree that the following statements represent important factors for PREMIS adoption.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
A. Preservation Metadata help resource managers in manging, analyzing data, or solving problems.	◯	◯	◯	◯	◯
B. Cultural heritage institutions are enthusiastic about the PREMIS	◯	◯	◯	◯	◯
C. In my opinion, implementing the PREMIS represents a desirable decision for our institution.	◯	◯	◯	◯	◯
D. PREMIS enable us to better diagnose preservation issues.	◯	◯	◯	◯	◯
E. By integrating PREMIS, my institution is helping other members to acquire the basic metadata skills.	◯	◯	◯	◯	◯
F. My colleagues and I enjoy figuring out how to use PREMIS effectively for a variety of resource management situations in our institution.	◯	◯	◯	◯	◯
G. PREMIS provide more opportunities for preservation.	◯	◯	◯	◯	◯
H. My institution was one of the first institutions to experiment with PREMIS	◯	◯	◯	◯	◯
I. Taking risks on new systems and standards that might enhance digital preservation management are worth the resource invested in them.	◯	◯	◯	◯	◯
J. My institution has the resources necessary to support the ongoing adoption of the PREMIS.	◯	◯	◯	◯	◯
K. There has been healthy discussion about adopting the PREMIS within this institution.	◯	◯	◯	◯	◯
L. The PREMIS is	◯	◯	◯	◯	◯

compatible with the long term access policy and procedure in our institution.					
M. Adopting PREMIS is improving the image of my institution	○	○	○	○	○
N. Adopting PREMIS is resulting in overall improvements of digital preservation activities at my institution.	○	○	○	○	○
O. There is room to make some local adaptations in how the PREMIS is implemented without jeopardizing its effectiveness.	○	○	○	○	○
P. There is limited research literature that shows PREMIS role and significant improvements in digital preservation as a result of PREMIS adoption.	○	○	○	○	○
Q. My institution is well informed about the PREMIS	○	○	○	○	○
R. My institution has the know-how to adopt the PREMIS.	○	○	○	○	○
S. Technical assistance is available to our institution as we proceed with the implementation process.	○	○	○	○	○
T. Employees involved in the implementation of the PREMIS know their efforts are appreciated by the institution.	○	○	○	○	○
U. The experience of other organizations adopting the PREMIS convinces me of its effectiveness.	○	○	○	○	○
V. My institution would be likely to adopt PREMIS, only as long as it requires natural and incremental changes to the existing system.	○	○	○	○	○

14. What do you see as the most important stimulants for facilitating adoption of PREMIS in your institution? (Please tick a maximum of 3 items).

- [ ] My institution has the resources necessary to support the initial adoption of the PREMIS.
- [ ] My institution has enough technical knowledge to adopt the PREMIS.
- [ ] Most cultural heritage institutions are adopting the PREMIS or seriously considering it.
- [ ] From a technical standpoint, it is/will be easy to implement the PREMIS.
- [ ] The PREMIS is compatibility with existing system.
- [ ] Interest from the decision-makers within our institution.
- [ ] Benefits will outweigh costs when it comes to adopting the PREMIS at our institution.
- [ ] Adopting the PREMIS is seen as a practical necessity by our institution.
- [ ] Other (Please elaborate on the nature of what motivates you to integrate and use PREMIS in your institution, and the incentives that encourage you to engage in this task.)

15. Although many institutions are highly motivated to integrate preservation metadata for resource management, to a greater or lesser extent cultural heritage institutions experience barriers that may prevent or discourage them from adopting PREMIS. What concerns (if any) did your institution have regarding the adoption of PREMIS? (Please tick a maximum of 3 items)

- [ ] Lack of training/expertise
- [ ] Too much training required for staff
- [ ] Usability requirements too high
- [ ] Lack of integration or incompatibility with existing system
- [ ] Our institution has a limited capacity to absorb negative consequences that might occur as a result of implementing the PREMIS.
- [ ] Lack of interest from the decision-makers within our institute.
- [ ] We lack the knowledge necessary to be confident in our ability to implement the PREMIS.
- [ ] Institutions that have adopted the PREMIS cannot provide evidence of its effectiveness.
- [ ] Adopting the PREMIS represents high risk to our institution.
- [ ] Our institution prefers to take a wait-and-see approach when it comes to tr
- [ ] Other (Please elaborate on the nature of barriers that you believe limit the adoption of PREMIS)

7. Additional Questions

Please answer the following short questions:

16. Please read each statement below, and mark an answer based on how much you believe the statement describes you.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. I can always manage to solve difficult problems if I try hard enough.	○	○	○	○	○
2. If someone opposes me, I can find means and ways to get what I want.	○	○	○	○	○
3. It is easy for me to stick to my aims and accomplish my goals.	○	○	○	○	○
4. I am confident that I could deal efficiently with unexpected events.	○	○	○	○	○
5. Thanks to my resourcefulness, I know how to handle unforeseen situations.	○	○	○	○	○
6. I can solve most problems if I invest the necessary effort.	○	○	○	○	○
7. I can remain calm when facing difficulties because I can rely on my coping abilities.	○	○	○	○	○
8. When I am confronted with a problem, I can usually find several solutions.	○	○	○	○	○
9. If I am in trouble, I can usually think of something to do.	○	○	○	○	○
10. No matter what comes my way, I'm usually able to handle it.	○	○	○	○	○
11. I expect extensive recommendations and lessons learned from others that I know and trust before I will try or adopt a new standard.	○	○	○	○	○
12. I am interested in assembling the different technology pieces that might solve the digital preservation challenges.	○	○	○	○	○
13. I am receptive to new digital resource management tools, even if they require drastic changes to the existing work flows and procedures.	○	○	○	○	○
14. With any new technologies, I will take a wait and see approach before trying it.	○	○	○	○	○
15. I get personal gratification from learning new products and tools.	○	○	○	○	○
16. I consider myself technologist.	○	○	○	○	○

17. You may provide any additional comments, if you would like:

18. Would you be available for a telephone interview to explore issues in more detail? (Time required 10 to 15 minutes)?

◯ No

◯ Yes -here is my telephone and/or e-mail address:

8. Thanks!

Thank you for providing your feedback on PREMIS adoption study through this survey! **Daniel Gelaw Alemneh dalemneh@library.unt.edu**

APPENDIX D

SEMI-STRUCTURED INTERVIEW QUESTIONS AND FOLLOW-UP EMAILS

Follow-up email for Interview

Dear …,

A few months ago you answered a survey on an Examination of the Extent of Adoption of Preservation Metadata in Cultural Heritage Institutions: An Exploratory Study Using Diffusion of Innovation Theory. The main goal is to identify and understand factors affecting adoption of PREservation Metadata Implementation Strategies (PREMIS) in cultural heritage institutions. Thank you!

I would also like to thank you for agreeing to participate in a follow-up interview of my research study. The 10 to 15 minute telephone interview will examine some of the responses that you have made in the questionnaire and explore the issues in more detail. For example, what do you think it means to be PREMIS-compliant? What other factors influenced decisions about PREMIS adoption in your repository? Etc.

All the information you provide will be held in the strictest confidence. You will not be identified in any report or publication resulting from this study. With your agreement, I would like to record our interview to facilitate the discussion and to ensure the accuracy of the interview data. Please let me know the number(s), convenient day and time to call. I am conducting the bulk of my interviews between Friday, March 28th and Friday, April 4th. If these days are inconvenient for you, please let me know and we can find a mutually acceptable time.

If you have any questions regarding this study, you may contact Dr. Samantha Hastings, University of South Carolina, at: 803-777-3858 (email at: shastings@gwm.sc.edu), or Dr. Brian O'Connor, UNT School of Library and Information Sciences at 940-565-2445 (email at: boconnor@lis.admin.unt.edu), or myself Daniel Alemneh at telephone number 940-891-6746 (email at: Daniel.Alemneh@unt.edu).

I thank you in advance for your assistance, and I look forward to speaking with you.
Yours sincerely,

Daniel Gelaw Alemneh

Follow-up and Confirmation Email for Interview

Dear ….

From our previous communication, our telephone interview has been set for:
Date:_____ at Time: _____,

If for any reason you would like to change this date or time or wish to cancel the interview, please contact me at telephone number [redacted] or by e-mail at: Daniel.Alemneh@unt.edu.

I thank you in advance for your assistance, and I look forward to speaking with you.

Yours sincerely,

Daniel Gelaw Alemneh
University of North Texas, Digital Projects Unit,
P.O.Box 305190; Denton, TX 76203

Follow-up Semi-Structured Interview Questions

(Note: Not all interviewees were asked all questions. Questions appropriate to each interviewee were selected from this general outline in light of their survey responses.)

Background Information about Interviewee.

Thank you for agreeing to participate in my exploratory research. The purpose of this study is essentially to identify factors that may affect adoption of the PREMIS.

- May I record our conversation?

We have completed as much of the background information below from the survey and from publicly available resources. Please review this information to determine its accuracy.

- Date and time of Interview:
- Institution/Project Name:
- Institution/Project Web Site:
- Your job title:
- What primary functions does your job involve?

Institutional Digital Preservation Activities and Decision-Making Process.

I'd like to know your institution's commitment to digital preservation and how you seek information about new developments related to digital preservation in general and preservation metadata in particular.

- How do you describe your institution digital preservation activities?
    - What preservation strategies are used or do you plan to use at your preservation repository? Why?

- How do you describe the role of metadata in general, and your institution‘s involvement in the application of preservation metadata in particular?

- How did the decision get made to adopt the PM system in your institution?
  - Were groups (stakeholders) in your institution involved in the decision to adopt the PREMIS?
  - What were the important factors influencing the decision?
  - What was your role in the decision-making process?
- How is your institution (department) organized in terms of management style and functional structure?
  - How do you interact with others (among your colleagues within your institution and with others in the cultural heritage community at large) when seeking or sharing information about new developments related to digital preservation

Specific questions related to PREMIS.

I’d like to focus specifically on PREMIS in your institution.

- How important has the PREMIS been in the development of your project?
  - How is your institution informed by the PREMIS?
- In your survey you indicated that you use [*institution’s chosen standards]* for managing your digital assets. You also mentioned that you are currently using [*name of standards*] metadata standards. Could you elaborate on that?
  - Do you plan to use other tools and/or standards?
  - How easy has it been (or is it going to be) to incorporate the PREMIS

elements into your system?

- What do you think it means to be PREMIS-compliant?

Factors Influencing PREMIS Adoption

One of the goals of the current research project is to identify factors that may affect PREMIS adoption and gather additional information about the positive (stimulants) and negative (barriers) factors that may encourage or discourage cultural heritage institutions from adopting PREMIS.

- What would you see as the major advantages of PREMIS in digital preservation activities in general?
    - What are the most important incentives that facilitate PREMIS adoption in your institution?
    - What are the enablers of effective PREMIS adoption your institution has utilized?
    - Have the expected positive impacts of adopting the PREMIS been realized at your institution?
- Based on your institution experience, please elaborate on the nature of barriers or major challenges that you believe limit the adoption of PREMIS by Cultural Heritage Institutions.
    - Do you think cultural heritage institutions need another preservation metadata or another approach to the PREMIS?

Summary and Final Words

- Are there any issues or any other aspects of PREMIS that we haven't covered that you think should be discussed here?

== Thank you for participating! ==

APPENDIX E

LIST OF FREQUENT CONCEPTS USED BY THE INTERVIEWEES AND QUALITATIVE DATA TAKEN FROM THE OPEN-ENDED COMMENTS

Digital Preservation and PREMIS:

- Digital preservation complexity:
    - When we accept the preservation responsibilities, we understand the notion that digital preservation is a complex process.
    - The digital preservation environment is full of unexpected events.
    - We learn and adapt as we go along.
    - Ground-breaking digital preservation ideas can come from anyone or any community.
- Impact and effectiveness of the PREMIS:
    - Flexible international preservation metadata is very useful.
    - PREMIS offers exciting possibilities for the digital library.
    - PREMIS is very important to our institution's digital preservation activities.
    - Our institution has long been aware of PREMIS and its benefits.
    - The advantages of PREMIS have been discovered and utilized by our institution.
    - Adopting PREMIS reduced the need for file-format based METS profiles.
    - A modular approach to adopting components of the PREMIS was employed by our institution's digital projects team.
    - Iterative and incremental developments help to ensure integration with existing systems and all possible preservation solutions.

- PREMIS is flexible and we have the option to leave some information out or in.
- PREMIS' flexibility and the ability to modify component in light of our specific institution requirements have been appreciated.
- PREMIS has enabled us to attain an unmatched depth of expertise in digital preservation.

Summaries of Limitations and Adoption Issues:

- Lack of resources:
  - Lack of time allotted for staff at all levels to explore and test PREMIS.
  - Ignorance from the side of management and other staff members.
  - Lack of time and money prevent our institution from adopting PREMIS at this point.
- Inadequate technical support and lesson-learned documents:
  - PREMIS is still not a stable standard.
  - There are too few adopters of PREMIS; only nine registered implementers, only nine registered implementers.
  - Institutions and individuals vary with depth of expertise or experience.
  - Need easy-to-use tools and more examples of adopting Events with METS.
  - We are unclear about how much of PREMIS we really need to implement.
  - PREMIS compliance definitions are varied across institutions.

- More established competitors out there:
    - No concrete plans yet to replace LMER with PREMIS.
    - We have to make major changes to DAITSS.
    - LMER does exactly what we need for our digital preservation strategy.
    - Other metadata approaches are as fruitful.
- Too much detail:
    - PREMIS remains too abstract with too many decision points and integration points with existing metadata approaches.
    - PREMIS offers a lot of choices which make it difficult to make a selection.
    - Too verbose.
- Presence of multiple stakeholders:
    - PREMIS needs to support a diversity of communities.
    - PREMIS gives more emphasis to libraries.
    - The rate of adoption among museums is minimal.
    - Not sure it will be very useful for my company.
    - We must take serious consideration of local conditions.
    - PREMIS rights are not a good fit for confidential data.
    - Undecided as to the full relevance.
    - It might be difficult for PREMIS to make big impact today for all communities.

Future of PREMIS:

- PREMIS will catch on:
    - The PREMIS has the potential to significantly enhance preservation activities.
    - Backed by Library of Congress.
    - We hope that PREMIS 2.0 will address the concerns we have about the PREMIS.
- Better coordination among stakeholders:
    - There is interest from the cultural heritage community as institutions are increasingly adopting PREMIS.
    - PREMIS is endorsed by a number of communities and societies.
    - Collaboration and co-operation between and among all stakeholders is of paramount importance to the successful adoption of PREMIS.

APPENDIX F

COEFFCIENTS AND CORRELATION FACTORS

Table-56

Coefficients for the Six Variables

Coefficients[a]										
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B		Correlations		
	B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part
(Constant)	.709	.669		1.060	.294	-.635	2.053			
Relative-Advantage	.368	.208	.248	1.769	.083	-.050	.785	.483	.245	.174
Compatibility	-.203	.228	-.114	-.894	.376	-.661	.254	.304	-.127	-.088
Complexity	-.339	.221	-.194	-1.531	.132	-.783	.106	.228	-.214	-.150
Trialability	.474	.191	.383	2.483	.017	.090	.858	.644	.334	.244
Observability	-.073	.267	-.035	-.272	.787	-.610	.465	.371	-.039	-.027
Institutional-Readiness	.502	.197	.412	2.542	.014	.105	.899	.615	.341	.250

a. Dependent Variable: Adoption Status

Table-57

Correlations among Adoption Factors and Adoption Level

		Adoption Level	Adoption Decision Status	Relative Advantage	Compatibility	Complexity	Trialability	Observability	Institutional-Readiness
Adoption Level	Pearson Correlation	1	.811(**)	.483(**)	.304(*)	.228	.644(**)	.371(**)	.615(**)
	Sig. (2-tailed)		.000	.000	.023	.091	.000	.005	.000
	N	56	56	56	56	56	56	56	56
Adoption Decision Status	Pearson Correlation	.811(**)	1	.397(**)	.328(*)	.175	.455(**)	.315(*)	.460(**)
	Sig. (2-tailed)	.000		.002	.013	.197	.000	.018	.000
	N	56	56	56	56	56	56	56	56
Relative Advantage	Pearson Correlation	.483(**)	.397(**)	1	.513(**)	.236	.482(**)	.623(**)	.427(**)
	Sig. (2-tailed)	.000	.002		.000	.080	.000	.000	.001
	N	56	56	56	56	56	56	56	56
Compatibility	Pearson Correlation	.304(*)	.328(*)	.513(**)	1	.455(**)	.485(**)	.339(*)	.497(**)
	Sig. (2-tailed)	.023	.013	.000		.000	.000	.011	.000
	N	56	56	56	56	56	56	56	56
Complexity	Pearson Correlation	.228	.175	.236	.455(**)	1	.468(**)	.240	.594(**)
	Sig. (2-tailed)	.091	.197	.080	.000		.000	.075	.000
	N	56	56	56	56	56	56	56	56
Trialability	Pearson Correlation	.644(**)	.455(**)	.482(**)	.485(**)	.468(**)	1	.461(**)	.738(**)
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000	.000
	N	56	56	56	56	56	56	56	56
Observability	Pearson Correlation	.371(**)	.315(*)	.623(**)	.339(*)	.240	.461(**)	1	.389(**)
	Sig. (2-tailed)	.005	.018	.000	.011	.075	.000		.003
	N	56	56	56	56	56	56	56	56
Institutional Readiness	Pearson Correlation	.615(**)	.460(**)	.427(**)	.497(**)	.594(**)	.738(**)	.389(**)	1
	Sig. (2-tailed)	.000	.000	.001	.000	.000	.000	.003	
	N	56	56	56	56	56	56	56	56

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

APPENDIX G

ABBREVIATION AND ACRONYMS WITH WEB ADDRESSES

AIP – Archival Information Package, (a concept from the OAIS Reference Model): *See also DIP and SIP:* http://public.ccsds.org/publications/archive/650x0b1.pdf

AHDS – Arts and Humanities Data Service (UK): http://ahds.ac.uk

ANSI – American National Standards Institute: http://www.ansi.org/

APSR – Australian Partnership for Sustainable Repositories: http://www.apsr.edu.au/

ARC – An archive file format (used by the Internet Archive): http://www.digitalpreservation.gov/formats/fdd/fdd000235.shtml

CAMiLEON – Creative Archiving at Michigan & Leeds: Emulating the Old on the New: http://newweb2.si.umich.edu/CAMILEON/

CASPAR – Cultural, Artistic and Scientific knowledge for Preservation, Access and Retrieval (Europe): http://www.casparpreserves.eu/

Cedars – CURL Exemplars in Digital Archiving (UK): http://www.leeds.ac.uk/cedars

CLIR – Council on Library and Information Resources: http://www.clir.org

CNI – Coalition for Networked Information: http://www.cni.org

CURL – Consortium of Research Libraries (UK): http://www.curl.ac.uk

DC – Dublin Core (a standard metadata element set):
http://dublincore.org/

DCC – Digital Curation Centre (UK):
http://www.dcc.ac.uk/

DDI – Data Documentation Initiative:
http://www.icpsr.umich.edu/DDI/

DigiCult – Digital Culture (European project/ Newsletter):
http://www.digicult.info/pages/index.html

DIP – Dissemination Information Package (a concept from the OAIS Reference Model)
see also AIP and SIP: http://public.ccsds.org/publications/archive/650x0b1.pdf

DLF – Digital Library Federation:
http://www.diglib.org

DPC – Digital Preservation Coalition (UK):
http://www.dpconline.org.

DPE – Digital Preservation Europe (building on the earlier European initiative of ERPANET):
http://www.digitalpreservationeurope.eu/

DRAMBORA – Digital Repository Audit Method Based on Risk Assessment (Europe):
http://www.repositoryaudit.eu/

DROID –Digital Record Object Identification:
http://droid.sourceforge.net

EPIC – European Preservation Information Centre:
http://www.knaw.nl/ecpa

ERPANET – Electronic Resource Preservation and Access Network (*See also DPE*): http://www.erpanet.org/

eScience – refers to global collaboration in key areas of science, and the next generation of infrastructure that will enable it: http://www.escience.org/ & http://www.nesc.ac.uk/ (UK)

FGDC – The Federal Geographic Data Committee: http://www.fgdc.gov/

GIF – Graphic Interchange Format (an image file format with lossy compression format): http://www.w3.org/Graphics/GIF/spec-gif87.txt

GILS – Government Information Locator Service: http://www.gpoaccess.gov/gils/

HEDS – Higher Education Digitization Service (UK): http://www.heds-digital.com/

InterPARES – International Research on Permanent Authentic Records in Electronic Systems: http://www.interpares.org

ISO – International Organization for Standardization: http://www.iso.org/

JISC – Joint Information Systems Committee (of the Higher & Further Education Councils, UK): http://www.jisc.ac.uk

JHOVE – JSTOR/Harvard Object Validation Environment: http://hul.harvard.edu/jhove/

LC – Library of Congress: http://www.loc.gov/index.html

LiWA – Living Web Archives (Europe):
http://www.liwa-project.eu/

MARC – MAchine Readable Cataloging:
http://www.loc.gov/marc/

METS – Metadata Encoding and Transmission Standard:
http://www.loc.gov/standards/mets/

MIX – Metadata for Images in XML Schema (NISO standard for technical metadata for still images): http://www.loc.gov/standards/mix/

MODS – Metadata Object Description Schema:
http://www.loc.gov/standards/mods/

MP3 – MPEG-1 Audio Layer 3 (a popular digital audio encoding and lossy compression format): http://www.mp3-tech.org/

MPEG – Moving Picture Experts Group:
http://www.mpegif.org/

NAVCC – The National Audio-Visual Conservation Center (of the Library of Congress):
http://mic.loc.gov/preservationists_portal/presv_navcc.htm

NEDLIB – Networked European Deposit Library:
http://www.kb.nl/nedlib

NESLI – National Electronic Site Licensing Initiative (UK):
http://www.nesli2.ac.uk

NDIPP – National Digital Information Infrastructure and Preservation Program:
http://www.digitalpreservation.gov/

NISO – National Information Standards Organization:
http://www.niso.org/

NLA – National Library of Australia:
http://www.nla.gov.au/

NSF – National Science Foundation:
http://www.nsf.gov/

OAIS – Open Archival Information System:
http://ssdoo.gsfc.nasa.gov/nost/isoas/overview.html

OCLC – Online Computer Library Center:
http://www.oclc.org/home

ODF – Open Document Format (an open source format for office applications):
http://www.odfalliance.org/

PADI – Preserving Access to Digital Information (Australia):
http://www.nla.gov.au/padi

PANDORA – Preserving and Accessing Networked Documentary Resources of Australia:
http://pandora.nla.gov.au

PDF –Portable Document Format (a proprietary but open standard [ISO 32000] file format):
http://www.adobe.com/products/acrobat/adobepdf.html

Planets – Preservation and Long-term Access through Networked Services (Europe):
http://www.planets-project.eu/

PNG –Portable Network Graphics (an open, extensible image format with lossless compression):
http://www.libpng.org/pub/png/

PRISM – Preservation, Reliability, Interoperability, Security, Metadata:
http://prism.cornell.edu/main.htm

PREMIS – Preservation Metadata Implementation Strategies:
http://www.loc.gov/standards/premis/

PRESTA – PREMIS Requirement Statement (a project of APSR):
http://www.apsr.edu.au/currentprojects/currentprojects.htm#presta

PRONOM – An online information system about data file formats and their supporting software (UK): http://www.nationalarchives.gov.uk/pronom/

PURL – Persistent Uniform Resource Locator:
http://purl.nla.gov.au

RDF – Resource Description Framework:
http://www.w3.org/RDF/

RLG – Research Libraries Group:
http://www.rlg.org

RTF – Rich Text Format:
http://www.biblioscape.com/rtf15_spec.htm

SGML – Standard Generalized Markup Language:
http://www.w3.org/MarkUp/SGML/

SHAMAN – Sustaining Access through Multivalent Heritage ArchiviNg:
http://shaman-ip.eu/

SIP – Submission Information Package. A concept from the OAIS Reference Model. *See also AIP and DIP*: http://public.ccsds.org/publications/archive/650x0b1.pdf

TASI – Technical Advisory Service for Images (UK): http://www.tasi.ac.uk

TIFF –Tagged Image File Format (a public domain raster file format for mainly storing images): http://partners.adobe.com/public/developer/tiff/index.html

TNA - The National Archives (UK): http://www.nationalarchives.gov.uk

UKOLN – UK Office for Library and Information Networking: http://www.ukoln.ac.uk

US-ASCII – American Standard Code for Information Interchange: http://www.wps.com/projects/codes/

VADS – Visual Arts Data Service (UK): http://vads.ahds.ac.uk

VRA – The Visual Resources Association: http://www.vraweb.org/

W3C – World Wide Web Consortium: http://www.w3.org/

WIPO – World Intellectual Property Organization: http://www.wipo.int/about-ip/en/

XML – Extensible Markup Language: http://www.w3.org/XML/

REFERENCES

Agarwal, R., & Prasad, J. (1997). The role of innovation characteristics and perceived voluntariness in the acceptance of information technologies. *Decision Sciences, 28*(3), 557-582.

Agarwal, R., & Prasad, J. (1998). A conceptual and operational definition of personal innovativeness in the domain of information technology. *Information Systems Research, 9*(2), 204-215.

Agarwal, R., & Prasad, J. (2000). A field study of the adoption of software process innovations by information systems professionals. *IEEE Transactions on Engineering Management, 47*(3), 295-308.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211.

Ajzen, I., & Fishbein, M. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research.* Reading, MA: Addison-Wesley.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice Hall.

Akkermans, H.A., & Helden, K. (2002). Virtuous and vicious cycles in ERP implementation: A case study of interrelations between critical success factors. *European Journal of Information Systems 11*, 35-46.

Alemneh, D. G., Hastings, S. K., & Hartman, C. N. (2002). A metadata approach to digital preservation: The University of North Texas Libraries' experience. *First Monday, 7*(9). Retrieved July 15, 2008 from http://www.uic.edu/htbin/cgiwrap/bin/ojs/index.php/fm/article/view/981/902

Allinson, J. (2006). *OAIS as a reference model for repositories: An evaluation*. Retrieved July 15, 2008 from http://www.ukoln.ac.uk/repositories/publications/oais-evaluation-200607/Drs-OAIS-evaluation-0.5.pdf

Anderson, M. (2008). Evolving a network of networks: The experience of partnerships in the National Digital Information Infrastructure and Preservation Program. *International Journal of Digital Curation, 3*(1), 4-14.

Argote, L., Beckman, S. L., & Epple, D. (1990). The persistence and transfer of learning in industrial settings. *Management Science, 36*, 140–154.

Atkins, D. et al. (2003) *Revolutionizing Science and Engineering through cyberinfrastructure*: National Science Foundation Blue-Ribbon Advisory Panel. Retrieved July 15, 2008, from http://www.communitytechnology.org/nsf_ci_report/report.pdf

Baker, W.H. (1987). Status of information management in small businesses. *Journal of Systems Management, 38*(4), 10-15.

Barker, T., & Frolick, M.N. (2003). ERP implementation failure: A case study. *Information Systems Management,* 20 (4), 43-49.

Bates, M., Manuel, S., & Oppenheim, C. (2007, January 30). Models of early adoption of ICT innovations in higher education. *Ariadne 50*. Retrieved July 15, 2008, from http://www.ariadne.ac.uk/issue50/oppenheim-et-al/

Baum, J. A. C., & Ingram, P. (1998). Survival-enhancing learning in the Manhattan hotel industry, 1898–1980. *Management Science, 44*, 996–1016.

Beagrie, N. (2001). Preserving UK digital library collections. *Program, 35,* 217-226.

Beagrie, N. (2003). *National digital preservation initiatives: An overview of developments in Australia, France, the Netherlands, and the United Kingdom and of related international activity.* Washington, DC: Council on Library and Information Resources (CLIR) and the Library of Congress.

Beagrie, N. (2006). Digital curation for science, digital libraries, and individuals. *International Journal of Digital Curation, 1*(1). Retrieved July 15, 2008, from

http://www.ijdc.net/./ijdc/article/view/6/5

Beagrie, N., & Greenstein, D. (1998). *A strategic policy framework for creating and preserving digital collections*. London: Arts and Humanities Data Service.

Beatty, R. C., Shim, J. P., & Jones, M. C. (2001). Factors influencing corporate Web site adoption: A time-based assessment. *Information & Management, 38*(6), 337-354.

Besser, H. (2000). Digital longevity. *handbook for digital projects: A management tool for preservation and access.* Andover, MA: Northeast Document Conservation Center.

Besser, H. (2002). The next stage: moving from isolated digital collections to interoperable digital libraries. *FirstMonday, 7*(6). Retrieved July 15, 2008, from http://www.uic.edu/htbin/cgiwrap/bin/ojs/index.php/fm/article/view/958/879

Bishoff, L., & Allen, N. (2004). *Business planning for cultural heritage institutions.* The Council on Library and Information Resources (CLIR). Retrieved July 15, 2008, from http://www.clir.org/pubs/reports/pub124/contents.html

Braak, J.V. (2001). Individual characteristics influencing teachers' class use of computers. *Journal of Educational Computing Research, 25*(2), 141-157.

Bradford, M., & Florin, J. (2003). Examining the role of innovation diffusion factors on the implementation success of enterprise resource planning systems. *International Journal of Accounting Information Systems, 4*(3), 205-225.

Brophy, P., & Frey, J. (2006), *Digital Curation Centre: Externally Moderated Reflective Self-evaluation: Report,* Digital Curation Centre, and Edinburgh. Retrieved July 27, 2008, from http://www.dcc.ac.uk/docs/DCC_Evaluation_Report_Final.pdf

Brown, C.V., & Vessey, I. (2000). ERP implementation approaches: Towards a contingency framework. *Proceedings of the 20th International Conference on Information Systems* (pp. 411-416). Charlitte, NC.

Brown, S, A. et al. (2002). Do I really have to? User acceptance of mandated technology. *European Journal of Information Systems, 11*, 283-295.

Bryant, G. A. (2006). *The adopter chasm: An investigation of characteristics of faculty adopters instructional technology and the impact upon faculty use.* Unpublished Dissertation, University of Cincinnati.

Buonanno, G. et al. (2005). Factors affecting ERP system adoption: A comparative analysis between SMEs and large companies. *Journal of Enterprise Information Management*, *18*(4), 384 – 426.

Burgess, L., Cooper, J., & Sargent, J. (2008). Optimising user acceptance of mandated Mobile Health Systems (MHS): The ePOC (electronic point-of-care) project experience. *21st Bled e Conference Proceedings*, June 15-18, 2008; Bled, Slovenia. Retrieved July 27, 2008, from http://domino.fov.uni-mb.si/proceedings

CEDARS (2001). *The CEDARS project report: April 1998 – March 2001*. United Kingdom. The CEDAR Projects Team. Retrieved July 15, 2008, from http://www.leeds.ac.uk/cedars/OurPublications/CedarsProjectReportToMar01.pdf

Chapman, S. (2003). Counting the costs of digital preservation: Is repository storage affordable*? Journal of Digital Information, 4*(2). Retrieved July 15, 2008, from http://jodi.tamu.edu/Articles/v04/i02/Chapman/

Chen, M. (2003). Factors affecting the adoption and diffusion of XML and Web services standards for E-business systems. *International Journal of Human Computer Studies, 58*(3), 259-279.

Chircu, A. M., & Kauffman, R. J. (2000). Limits to value in electronic commerce-related IT investments. *Journal of Management Information Systems, 17*(2), 59-80.

Church, A. H. (2001). Is there a method to our madness? The impact of data collection methodology on organizational survey results. *Personnel Psychology, 54*, 937-969.

Connaway, L. S., O'Neill, E. T., & Prabha, C. (2006). Last copies: What's at risk? *College and Research Libraries, 67*(4), 370-379.

Connertz, T. (2003). Long-term archiving of digital documents: What efforts are being made in Germany? *Learned Publishing, 16*(3), 207-211.

Consultative Committee for Space Data Systems (2002) *Reference Model for an Open Archival Information System (OAIS)*, CCSDS 650.0-B-1, Blue Book. Retrieved July 15, 2008, from http://public.ccsds.org/publications/archive/650x0b1.pdf.

Cooper, R. B., & Zmud, R. W. (1990). Information technology implementation research: A technological diffusion approach. *Management Science, 36*(2), 123-139.

Cotora, L. (2007).Managing and measuring the intangibles to tangibles value. *Measuring Business Excellence, 11*(1), 53-60.

Crum, M. R., Premkumar, G., & Ramamurthy, K. (1996). An assessment of motor carrier adoption, use, and satisfaction with EDI. *Transportation Journal, 35*(4), 44-57.

Daft, R. L. (1978). A dual-core model of organizational innovation. *Academy of Management Journal, 21*(2), 193-210.

Dappert, A., & Enders, M. (2008). Using METS, PREMIS and MODS for archiving ejournals. *D-Lib Magazine, 14*(9/10). Retrieved October 29, 2008, from http://www.dlib.org/dlib/september08/dappert/09dappert.html

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of Information Technology. *MIS Quarterly, 13*(3), 319-340.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35*, 982-1003.

Day, M. (1998). Online serials: Preservation issues. *The Serials Librarian, 33*(3/4), 199-

221.

Day, M. (2001). E-Print services and long-term access to the record of scholarly and scientific research. *Ariadne, 28*. Retrieved July 15, 2008, from http://www.ariadne.ac.uk/issue28/metadata/.

Day, M. (2006). The long-term preservation of Web content. In Julien Masanes (Ed.), *Web Archiving* (pp. 177-199). Berlin Heidelberg: Springer-Verlag.

Ercegovac, Z. (1999). Introduction. *Journal of American Society for Information Science*, *50*(13), 1165-1168.

Fichman, R. G. (2001). The role of aggregation in the measurement of IT-related organizational innovation. *MIS Quarterly, 25*(4), 427-455.

Fichman, R. G., & Kemerer, C. F. (1997). The assimilation of software process innovations: An organizational learning perspective. *Management Science, 43*(10), 1345-1363.

Fichman, R. G., & Kemerer, C. F. (1999). The illusory diffusion of innovation: An examination of assimilation gaps. *Information Systems Research, 10*(3), 255.

Finnie, J. (1988). The role of financial appraisal in decisions to acquire advanced manufacturing technology. *Accounting and Business Research, 18*(7), 133-139.

Gallivan, M. J. (2001). Organizational adoption and assimilation of complex technological innovations: Development and application of a new framework. *The DATABASE for Advances in Information Systems, 32*(3): 51-85.

Geoghegan, W. H. (1994). *What ever happened to instructional technology?* Paper presented at the 22nd Annual Conference of the International Business Schools Computing Association. Baltimore, Maryland. Retrieved July 25, 2008, from http://eprints.ecs.soton.ac.uk/10144/ .

Giaretta, D. (2006). CASPAR and a European infrastructure for digital preservation. *ERCIM News Online Edition, 66*. Retrieved July 25, 2008, from http://www.ercim.org/publication/Ercim_News/enw66/giaretta.html.

Granger, S. (2002). Digital preservation and deep infrastructure. *D-Lib Magazine, 8*(2).Retrieved July 25, 2008, from http://www.dlib.org/dlib/february02/granger/02granger.html.

Grimson, J., Grimson, W., & Hasselbring, W. (2000). The SI challenge in health care. *Communications of the ACM, 43*(6), 49-55.

Guenther, R., (2008). Battle of the buzzwords; flexibility vs. interoperability when implementing PREMIS in METS. *D-Lib Magazine, 14*(7/8), Retrieved October 29, 2008, from http://www.dlib.org/dlib/july08/guenther/07guenther.html.

Hedstrom, M. (1998). Digital preservation: A time bomb for digital libraries. *Computers and the Humanities, 31*(3), 189-202.

Hedstrom, M. (Ed.). (2003) *It's about time: Research challenges in digital archiving and long-term preservation*: Final report on the NSF Workshop on Research Challenges in Digital Archiving and Long-Term Preservation, April 12-13, 2002, Washington, DC. Retrieved July 25, 2008, from http://www.digitalpreservation.gov/library/pdf/NSF.pdf .

Hedstrom, M., & Lampe, C. (2001). Emulation vs. migration: Do users care? *RLG DigiNews, 5*(6). Retrieved July 25, 2008, from http://webdoc.gwdg.de/edoc/aw/rlgdn/preserv/diginews/diginews5-6.html.

Heminger, A. R., & Kelley, D. M. (2005). Assessing the Digital Rosetta Stone model for long-term access to digital documents. *Journal of Management Information System, 21*(4), 11-35.

Hildreth, P. & Kimble, C. (Eds.) (2004). *Knowledge networks: Innovation through communities of practice*. Hershey, PA: Idea Group Inc.

Kautz, K., & Pries-Heje, J. (Eds.). (1996). *Diffusion and adoption of information technology*. London: Chapman and Hall.

Kenney, A. R., & Rieger, O. Y. (2000). Preserving digital assets: Cornell's digital image collection project. *First Monday, 5*(6). Retrieved July 16, 2008, from http://firstmonday.org/issues/issue5_6/kenney/index.html.

Khoumbati, K., Themistocleous, M., & Irani, Z. (2006). Investigating enterprise application integration benefits and barriers in healthcare organizations: An exploratory case study. *International Journal of Electronic Healthcare 2*(1), 66-78.

Khoumbati, K. et al. (2007). Broadband adoption in Pakistan. *Electronic Government 4*(4), 451-465.

Kravchyna, V. (2004). *Information needs of art museum visitors: Real and virtual.* Unpublished PhD Dissertation, University of North Texas.

Kuan, K. & Chau, P. (2001). A perception-based model for EDI adoption in small businesses using a technology-organization-environment framework. *Information and Management, 38*(8), 507-521.

LaRose, R. & Hoag, A. (1996). Organizational adoptions of the Internet and the clustering of innovations. *Telematics and Informatics, 13*(1), 49-61.

Lavoie, B. (2004). Preservation metadata: Challenge, collaboration, and consensus. *Microform and Imaging Review 33*(3), 130-134.

Lavoie, B. (2008). PREMIS With a fresh coat of paint: Highlights from the revision of the PREMIS data dictionary for preservation metadata. *D-Lib Magazine*, *14*(5/6). Retrieved July 16, 2008, from http://www.dlib.org/dlib/may08/lavoie/05lavoie.html.

Lavoie, B., & Dempsey, L. (2004). Thirteen ways of looking at...digital preservation. *D-Lib Magazine, 10*(7/8). Retrieved July 16, 2008, from http://www.dlib.org/dlib/july04/lavoie/07lavoie.html.

Lavoie, B., & Gartner, R. (2005) *Technology watch report: preservation metadata.* DPC Technology Watch Series Report 05-01. Retrieved July 16, 2008, from http://www.dpconline.org/docs/reports/dpctw05-01.pdf .

Lazinger, S. (2001). *Digital preservation and metadata: History, theory, practice.* Englewood, CO: Libraries Unlimited.

Lee, C. A. (2005). *Defining digital preservation work: A case study of the development of the Reference Model for an Open Archival Information System.* Unpublished PhD Dissertation, University of Michigan.

Lee, C. A. & Tibbo, H. R. (2007). Digital curation and trusted repositories: Steps toward success. *Journal of Digital Information 8*(2). Retrieved July 16, 2008, from http://journals.tdl.org/jodi/article/view/229/183

Lee, C. A., Tibbo, H. R. & Schaefer, J. C. (2007). Defining what digital curators do and what they need to know: The DigCCurr project. In: *JCDL07: Proceedings of the 7th ACM/IEEE-CS Joint Conference on Digital Libraries* (pp. 49-50). New York: ACM.

Light, P.C. (1998). *Sustaining innovation*. San Francisco: Jossey-Bass.

Lyman, P., & Varian, H. (2003). *How much information?* University of California at Berkeley, School of Information Management and Systems. Retrieved January 17, 2008 from: http://www.sims.berkeley.edu/how-much-info-2003.

Lynch, C. (2003). Institutional repositories: Essential infrastructure for scholarship in the digital age. *Portal: Libraries and the Academy*, *3*(2), 327-336.

Mabert, A.V., Soni, A., & Venkataramanan, M.A. (2001), Enterprise resource planning: Common myths versus evolving reality. *Business Horizons*, *44*(3), 69-76.

Mantzana, V., & Themistocleous, M. (2005). Towards a conceptual framework of actors and factors affecting the EAI adoption in healthcare organisations. *Proceedings of the 13th European Conference on Information Systems, ECIS 2005,* Regensburg,

Germany, May 26-28, 2005. Retrieved July 16, 2008, from http://is2.lse.ac.uk/asp/aspecis/20050100.pdf .

Marcum, D. M. (2001). Digital preservation: an update. In D. M. Marcum (Ed.), *Development of Digital Libraries: An American Perspective* (pp. 148-154). Westport, Connecticut: Greenwood Press.

Mathieson, K. (1991). Predicting user intentions: Comparing the technology acceptance model with the theory of planned behavior. *Information Systems Research, 2*(3), 173–191.

May, T. (1993). *Social research: Issues, methods and process*. Buckingham: Open University Press.

Mellor, P. (2003). CAMiLEON: Emulation and BBC domesday. *RLG DigiNews, 7*(2). Retrieved July 16, 2008, from http://digitalarchive.oclc.org/da/ViewObjectMain.jsp?fileid=0000070519:000006287396&reqid=207.

Mellor, P., Wheatley, P., & Sergeant, D. (2002). Migration on request: A practical technique for digital preservation. *ECDL 2002*. Retrieved July 31, 2008, from http://www.si.umich.edu/CAMILEON/reports/migreq.pdf.

Minder, C. (2003). Factors affecting the adoption and diffusion of XML and Web services standards for E-business systems. *International Journal of Human-Computer Studies, 58*(3), 259-279.

Moen, W. (2001). The metadata approach to accessing government information. *Government Information Quarterly, 18*(3), 155-165.

Moore, G. (1991). *Crossing the chasm: Marketing and selling disruptive products to mainstream customers*. New York: Harper.

Moore, G. (2002). *Crossing the chasm: Marketing and selling disruptive products to*

mainstream customers (Rev. ed.). New York, Harper Business Essentials.

Moore, G., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research, 2*(3), 192-222.

Moore, R. (2008). Towards a theory of digital preservation. *International Journal of Digital Curation, 3*(1), 63-75.

Morales-Arroyo, M. A. (2003). *The physiology of collaboration, an investigation of library-museum-university partnerships.* Unpublished PhD Dissertation, University of North Texas.

Mustonen-Ollila, E., & Lyytinen, K. (2003). Why organizations adopt information system process innovations: A longitudinal study using diffusion of innovation theory. *Information Systems Journal, 13*(3), 275-297.

National Library of Australia (2008). *PANDORA Digital Archiving System (PANDAS).* NLA Retrieved July 16, 2008, from http://pandora.nla.gov.au/pandas.html.

National Library of New Zealand (2008). *The National Digital Heritage Archive (NDHA)* Retrieved July 16, 2008, from http://www.natlib.govt.nz/about-us/current-initiatives/ndha.

Neuendorf, K. A. (2002). *The content analysis guidebook.* Thousand Oaks, CA: Sage.

Neuman, W. L. (1991). *Social research methods: Qualitative and quantitative approaches*. Boston, MA: Allyn and Bacon.

OCLC/RLG Working Group on Preservation Metadata. (2001). *Preservation metadata for digital objects: A review of the state of the art.* Retrieved July 16, 2008, from http://www.oclc.org/research/pmwg/presmeta_wp.pdf.

OCLC/RLG Working Group on Preservation Metadata. (2002). *Preservation metadata*

and the OAIS Information Model a metadata framework to support the preservation of digital objects. Retrieved July 16, 2008, from http://www.oclc.org/research/projects/pmwg/pm_framework.pdf.

Oguz, F. (2007). *An exploration of the diffusion of a new technology from communities of practice perspective: Web services technologies in digital libraries*. Unpublished PhD Dissertation, University of North Texas.

PADI. (2008). *Encapsulation.* The National Library of Australia's Preserving Access to Digital Information (PADI). Retrieved July 16, 2008, from http://www.nla.gov.au/padi/topics/20.html

Pomerantz, J. (2006). Google Scholar and 100% availability of information. *Information Technology and Libraries, 25*(1), 52-56.

Powell, R. R. (1997). *Basic research methods for librarians* (3rd ed.). Greenwich, CT: Ablex.

PREMIS Working Group (2005). *Data Dictionary for preservation metadata: Final report of the PREMIS Working Group.* Retrieved July 16, 2008, from http://www.oclc.org/research/projects/pmwg/premis-final.pdf.

PREMIS Editorial Committee (2008). *PREMIS Data Dictionary for preservation metadata, version 2.0*. Retrieved July 16, 2008, from http://www.loc.gov/premis/v2/premis-2-0.pdf.

PREMIS in METS Working Group, (June 2008). Guidelines for using PREMIS with METS for exchange. Retrieved October 29, 2008, from http://www.loc.gov/standards/premis/guidelines-premismets.pdf.

Prom, C. J. (2003). Reengineering archival access through the OAI protocols. *Library Hi Tech, 21*(2), 199-209.

Research Library Group (2002). *Trusted digital repositories: attributes and*

responsibilities. RLG-OCLC Report. Retrieved July 16, 2008, from http://www.oclc.org/programs/ourwork/past/trustedrep/repositories.pdf.

Robertson, S.B. (1996). *Digital Rosetta Stone: A conceptual model for maintaining long-term access to digital documents*. Master's thesis, School of Logistics and Acquisition Management, Air Force Institute of Technology, Wright-Patterson AFB, OH.

Rogers, E. M. (1995). *Diffusion of innovations* (4th ed.). New York: The Free Press.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York: The Free Press.

Rogers E. M., & Scott, K. L. (1997). The diffusion of innovations model and outreach from the national network of libraries of medicine to Native American communities. Retrieved July 16, 2008, from http://www.au.af.mil/au/awc/awcgate/documents/diffusion/rogers.htm.

Roman, R. (2003). Diffusion of innovations as a theoretical framework for Telecenters. *Information Technologies & International Development, 1*(2), 53-66.

Ross, S., & Hedstrom, M. (2005). Preservation research and sustainable digital libraries. *International Journal on Digital Libraries, 5* (4), 317-325.

Rothenberg, J. (1995). Ensuring the longevity of digital information. *Scientific American, 272*(1), 24-29.

Rothenberg, J. (1998). *Avoiding technological quicksand: Finding a viable technical foundation for digital preservation*. Report to Council on Library and Information Systems, Commission on Preservation and Access, Washington, DC.

Rothenberg, J. (2000). *An experiment in using emulation to preserve digital publications.* Den Haag: Koninklijke Bibliotheek.

Rothenberg, J. (2002). Preservation of the Times. *Information Management Journal,*

36(2), 38-43.

Ryan, B., & Gross, N. C. (1943). The diffusion of hybrid seed corn in two Iowa communities. *Rural Sociology 8*, 15-24.

Sahin, I. (2006). Detailed review of Rogers' Diffusion of Innovations theory and educational technology-related studies based on Rogers' Theory. *The Turkish Online Journal of Educational Technology TOJET 5*(2). Retrieved July 23, 2008, from http://www.tojet.net/articles/523.htm.

Sillince, J.A.A. et al. (1998). Email adoption, diffusion, use and impact within small firms: A survey of UK companies. *International Journal of Information Management, 18 (*4), 231-242.

Steenbakkers, J. F. (2003). Permanent archiving of electronic publications. *Serials*, *16*(1), 33-36.

Steenbakkers, J. F. (2005). Digital archiving in the twenty-first century: Practice at the National Library of the Netherlands. *Library Trends*, *54*(1), 33-56.

Straub, D. W. (1994). The effect of culture on IT diffusion: E-mail and fax in Japan and the U.S. *Information Systems Research, 5*(1), 23-47.

Sutton, S. (1999). Conceptual design and deployment of a metadata framework for educational resources on the Internet. *Journal of the American Society for Information Science and Technology, 50*(13), 1182-1192.

Swanson, E. B. (2001). Telling an innovation story. In Mark A. Ardis & Barbara L. Marcolin (Eds.): *Diffusing Software Products and Process Innovations*, IFIP TC8 WG8.1 (pp. 1-4) Fourth Working Conference on Diffusing Software Products and Process Innovations, April 7-10, 2001, Banff, Canada.

Tan, M., & Teo, T. S. H. (2000). Factors influencing the adoption of Internet banking. *Journal of the Association for Information Systems, 1*(5), 1-42.

Tarde, G. (1903). *The Laws of imitation*, (Clews Parsons, E. Trans.). New York: Holt.

Taylor, S. & Todd, P. (1995). Assessing IT usage: The role of prior experience. *MIS Quarterly 19*(4), 561–570.

Tennant, R. (1999). Time is not on our side: The challenge of preserving digital materials. *Library Journal, 15,* 30-31.

Teper, T. H., & Kraemer, B. (2002). Long-term retention of electronic theses and dissertations. *College & Research Libraries, 63,* 61-72.

Themistocleous, M. (2004). Justifying the decision for EAI implementations: A validated proposition of factors. *Journal of Enterprise Information Management, 17*(2), 85-104.

Themistocleous, M., & Irani, Z. (2002). A model for adopting enterprise application integration technology. *The Adoption and Diffusion of IT in an Environment of Critical Change (IFIP WG8.*6), 61-75.

Thong, J. & Yap, C. (1996). Information systems effectiveness: A user satisfaction approach. *Information Processing and Management, 32*(5), 601-610.

Tibbo, H. (2003). On the nature and importance of archiving in the digital age. *Advances in Computers 57,* 2-69.

Tornatzky, L. G., & Fleischer, M. (1990). *The processes of technological innovation*. Lexington, MA: Lexington Books.

Tornatzky, L. G., & Klein, K. J. (1982). Innovation characteristics and innovation adoption-implementation: A meta-analysis of findings. *IEEE Transactions on Engineering Management, 29*(1), 28-45.

Van der Hoeven, J. (2004). *Permanent access technology for the virtual heritage:The endeavour for continuous rendering.* Research Task IN4140, IBM Netherlands N.V. Retrieved July 28, 2008, from http://jeffrey.famvdhoeven.nl/dd/

Van der Hoeven, J., Lohman, B., & Verdegem, R. (2007). Emulation for digital preservation in practice: The results. *The International Journal of Digital Curation, 2*(2). Retrieved July 16, 2008, from http://www.ijdc.net/ijdc/article/view/50/56

Van der Veen, M. (2004) *Explaining e-business adoption: Innovation & entrepreneurship in Dutch SMES.* [Unpublished?] doctoral dissertation, University of Twente, Netherlands. Retrieved July 16, 2008, from http://www.utwente.nl/nikos/research/dissertations/veen/dissertationmvdv.pdf

Van Wijngaarden, H. (2007). Preservation actions: What, how and when? *Tools and Trends: International Conference on Digital Preservation.* [Paper presented at?] 1-2 November 2007, Koninklijke Bibliotheek, Hague, the Netherlands. Retrieved August 6, 2008, from http://www.kb.nl/hrd/congressen/toolstrends/presentations/Van-Wijngaarden.pdf

Venkatesh, V. et al. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425-478.

Waller, M., & Sharp, R. (2006, February). Mind the gap: assessing digital preservation needs in the UK. *DPC.* Retrieved January 17, 2008, from: http://www.dpconline.org/graphics/advocacy/press/uknafeb06.html.

Wejnert, B. (2002). Integrating models of diffusion of innovations: A conceptual framework. *Annual Review of Sociology 28*, 297–326.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge: Cambridge University Press.

Wixom, B. H., & Todd, P. A. (2005). A theoretical integration of user satisfaction and technology acceptance. *Information Systems Research, 16*(1), 85-102.

Woodyard-Robinson, D. (2007). *Implementing the PREMIS data dictionary: A survey of approaches.* Woodyard-Robinson Holdings Ltd. Retrieved October 17, 2008, from http://www.loc.gov/standards/premis/implementation-report-woodyard.pdf

Wu, C. (2004). A readiness model for adopting Web services. *The Journal of Enterprise Information Management, 17*(5), 363-371.

Wu, H., Hsu, Y., & Hwang, F. (2007). Factors affecting teachers' adoption of technology in classrooms: Does school size matter? *International Journal of Science and Mathematics, 6*(1), 63-85.

Young, A. (2007). Factors affecting adoption of open source software by individuals. Paper presented at *the LinuxConf 07*, January 15-20, 2007, Sydney, Australia. Retrieved July 15, 2008, from http://lca2007.linux.org.au/Miniconfs/Research/Paper/AdoptionOSS.html

Zeng, M. (1999). Metadata elements for object description and representation: A case report from a digitized historical fashion collection project. *Journal of the American Society for Information Science and Technology, 50*(13), 1193-1208.