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METS: Flexibility v. Interoperability

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Abstract

This paper examines whether projects making use of the METS metadata schema do so due to its flexibility or its interoperability. Projects listed in the METS Implementation Registry of the Library of Congress METS Official Web Site, as well as selected case studies are analyzed for the reason METS was used in their projects. Data gathered from these sources is consolidated and further analyzed using cluster analysis in order to answer the research questions: 1) Can it be said that METS is being selected for projects based primarily on one of two criteria: its flexibility or its interoperability?" And if this is the case: 2) Is one of these two attributes (flexibility or interoperability) selected for more than the other? The paper concludes that flexibility has a slight edge over interoperability in terms of the primary reason for using METS in the projects analyzed for the paper.

Keywords: METS metadata, flexibility, interoperability

ME

TS: Flexibility v. Interoperability

Various metadata schemas have been formulated and continue to emerge as a myriad of user communities try to take advantage of the benefits that digitization offers both in the area of preservation and in the area of sharing information and making it more accessible. Metadata schemas appropriate for a given user community provide frameworks and methods for handling syntax and semantics that help standardize the way information associated with objects—both simple and complex—is communicated. These schemas, according to Zeng and Qin (2008) are constructed around three principles: simplicity, extensibility, and interoperability. This paper is concerned with the principles of extensibility and interoperability as they relate to the Metadata Coding and Transmission Standard (METS) schema. More specifically, it looks at how the ability of METS to incorporate other schemas into one record makes it a flexible schema able to handle metadata associated with complex digital objects. It also looks at the use of METS in data transfer and storage implementations important to digital repository projects. McDonough (2004) writes that one of the disadvantages of METS is that its flexibility in accommodating different metadata schemas may interfere with interoperability. This paper interrogates the problem of flexibility versus interoperability in projects making use of METS, examining the way that METS has been, or is being implemented in a variety of projects. It asks the question: "Can it be said that METS is being selected for projects based primarily on one of two criteria: its flexibility or its interoperability?"

METS is noted for its strengths in both of flexibility and interoperability. The question is important in that, if flexibility and interoperability are truly at odds when using METS, it is to be expected that one aspect would be favored over the other in specific implementations, and data

might reveal in which aspect (flexibility or interoperability) METS is stronger by studying these implementations.

This paper is organized into the following sections: literature review, methodology, results, discussion, and conclusion. The literature review section describes a brief history of the development of METS in addition to describing various implementations of the schema. The methodology section describes the type of data utilized, how it was obtained, and the statistical method used for analyzing the data. The results section provides a table consolidating the data for each project as it relates to flexibility or interoperability, the reasoning behind how projects were categorized according to flexibility or interoperability, and a pie chart interpreting the data for evaluative purposes. The data is evaluated in the discussion section, and the frequency of selection of METS as a metadata schema for projects for reasons of flexibility or interoperability, and how these two compare to each other is discussed in the conclusion.

Literature Review

The Metadata Encoding and Transmission Standard (METS) is an XML-based metadata schema that has the flexibility to accommodate multiple schema and the interoperability to support sharing of resources between institutions. The following literature describes a brief history of the standard, and various implementations of the standard in an effort to explore trends in its usage. An exploration of the following literature will be useful in determining what project designers and implementers are identifying as primary and subsidiary concerns in selecting METS for use in their projects.

According to Cundiff (2004), METS originated due to the desire of the library community to move to an XML-based standard in order to better accommodate electronic resources. Digital

and metadata management standards such as MPEG-7, RDF, and others were in development in the early part of first decade of twenty-first century. Developing XML-based standards were contesting the incumbent method of encoding records for the library community. The author recounts the meetings associated with, and the development of the MoA II DTD which utilized XML. The author describes how the MoA II DTD was revised after problems were identified and emerged as the Metadata Encoding and Transmission Standard (METS) in 2004. Important aspects of METS are described in sections of the article that pertain to the type of metadata the section covers. Seven major subsections of a METS document are described as: 1) METS Header, 2) Descriptive Metadata Section, 3) Administrative Metadata Section, 4) File Section, 5) Structural Map, 6) Structural Links, and 7) Behavioral Section. Although all of these subsections combine to make METS a powerful tool for a vast assortment of projects associated with the management, dissemination, and preservation of digital objects, the structural and behavioral sections have proven to be especially useful for dissemination purposes in many digital library projects.

Tennant (2004) describes the old standards used by the library cataloging community—MARC records, AACR2—as not being good fits for library activities and materials like "interlibrary loan systems, working paper repositories, and directories of online resources such as e-journals and databases" (p. 175). The author campaigns for a new standard that will better meet the needs of the library community. He specifically refers to METS in the area of extensibility, or the ability to apply extensions to METS records. Tennant (2004) envisions this extensibility as an asset in that it allows for experimentation in utilizing the standard as the need arises. He also

specifically highlights the usefulness of METS as a container schema allowing for transmission of complex digital objects to digital repositories.

McDonough (2004) announces the METS standard describing it as a metadata standard used to encapsulate descriptive, administrative and structural metadata used to display, manage, and preserve digital library objects. Digital library objects include not only books and other print publications that have been converted to digitized format, but also still images, audio, video, and complex objects using multiple formats. McDonough refers to METS's capability of handling these digital objects in the three major forms of "information packages" that are necessary for resources to be shared between institutions. These three packages are: the submission package (SIP), archival information package (AIP), and the dissemination package (DIP). McDonough describes the purpose of each of the packages as follows: the SIP is used to submit digital objects to repository systems; the AIP is used to store digital objects at a repository; and the DIP is used to disseminate digital objects to the requesting user. The ability of the differing systems of institutions to receive and process these information package is called interoperability. The author describes the stage of development of the standard at its public release in version 1.3, and the pros and cons of its usage. The pros include its flexibility, power, and its relative ease of use in encoding digital library objects. The cons as of the writing of this article include its flexibility as a barrier to interoperability because descriptive standards may vary between institutions.

Although interoperability can be affected by the flexibility of METS, it was selected as the metadata schema to be utilized by the National Digital Newspaper Program (NDNP). Murray (2004) writes about the utilization of METS in this twenty-year digital initiative to create an online resource for researching historical newspapers. The aim of the project is to digitize

selected newspapers from 1690 on that mostly exist on microfilm, and progressively make them available for full-text searching. Since this project involved the aggregation of over fifty projects, a structured metadata standard was desired. According to the author, METS was selected for its ability to handle complex links to compound objects. This particular case study of METS focusses on interoperability.

The ability of METS to handle the SIP, AIP, and DIP aspects of information packages makes it an especially powerful tool for born-digital objects. Guenther and Myrick (2006) argue that among the schema for managing complex digital objects—DIDL, METS, and IMS-CP—METS is best qualified for use in OAIS-compliant repositories. The MINERVA web preservation project of the Library of Congress was designed to collect and preserve born-digital objects, and especially open access objects according to the authors. The MINERVA project utilizes METS to accomplish this purpose. This particular utilization of METS speaks to preservation of born-digital objects in particular.

METS serves as a transmission schema for many projects related to deposit of METS records into digital library repositories. Chen and Reilly (2011) describe the experience of the small Digital Services Department of the University of Houston Digital Library (UHDL) in identifying and utilizing a combination of metadata standards in meeting their departmental mission. This mission calls upon the department to supply access to digital objects held by UHDL, facilitate the ingestion into the institutional depository of electronic theses and dissertations, and ensure stable, enduring storage of digital objects. The authors describe the reasoning behind adopting a METS/MIX/DC combination of schema in addressing the need to transmit, disseminate, and preserve digital objects within the context of membership and collaboration in the Texas Digital

Library (TDL) consortium which allocates archival storage space to member institutions. The authors mention the METS official website and the implementations various institutions registered on the "METS Implementation Registry" page, but only in passing, observing that, "Most implementations are based on a homegrown system and on adopting existing metadata standards that the institutions have already used to describe the digital objects" (p. 85). The specific interest of the Digital Services Department was to develop an automated method for transforming DC descriptive data records and MIX technical metadata records into METS records for storage. So the METS component in this case was ultimately to address the preservation of digital objects.

The use of XML for encoding in the METS schema gives METS records the advantage of interoperability. METS compatibility with tools used for ingestion by digital repositories makes it a useful transmission schema. Many ingestion tools at repository libraries have been designed to be compatible with XML encoded schema, meaning that these types of records can be submitted easily to digital repositories. Lagoze, Payette, Shin, and Wilper (2006) describe the open source digital repository service, Fedora. One important aspect of this service is its ability to disseminate content from complex objects that may have components stored in a variety of physical locations. METS has the capacity for referencing content external to the actual METS record in addition to utilizing XML. This makes the METS schema compatible with institutions that utilize the Fedora repository service. Walsh (2010) describes another important aspect of the use of METS in transmission. The author describes The Knowledge Bank as a joint initiative between the Oregon State University Libraries (OSUL) and the OSU Office of the Chief Information Officer. The initiative design calls for collecting, preserving, and distributing the

digital intellectual output of OSU's faculty, staff, and students. This goal is to be accomplished efficiently by batch loading this output into the DSpace repository. This process is made possible by the compatibility of METS records with DSpace package importers such as the Metadata Encoding Transmission Standard Information Package (METS SIP). In another project Bell and Lewis (2006) describe the use of METS as a transmission schema for deposit e-theses from The University of Wales Aberystwyth (UWA) into the archival repository at the National Library of Wales (NLW). In this case, compatibility with Fedora was also a positive attribute that led project designers to select it for use.

METS has specific strengths related to its ability to handle structural metadata. Dappert and Enders (2010) write about the specific types of metadata and how various schemas are utilized to address these specific concerns. Of particular interest to this discussion is the section on "metadata containers." The authors describe METS and MPEG-21 DIDL as metadata container schemas in that they are used to aggregate descriptive, administrative, technical, structural, and the accompanying physical representations of objects into one record. The authors describe the importance of structural metadata in associating an object with its manifestations and associated files. The ability to house these types of data in one record has important implications for behavioral aspects of dissemination, namely in viewing objects with page-turning behaviors such as e-books or other objects that must have structure described in order to view them properly. Dulock and Cronin (2009) describe the usefulness of METS in their case study of the Sanborn Map Company project at the University of Colorado at Boulder. The project involves the digitization of maps made by the Sanborn Map Company beginning in the 1860s. The authors

write about the importance of the ability of METS to address structure in reconstructing these maps, which are made up of multiple sheet that display one map when reconstructed properly.

In another project that speaks to the dissemination aspect of METS, Proffitt (2004) writes about the use of METS by the Research Library Group (RLG) in their Cultural Materials Initiative (RCM). The materials referenced in the RCM database are described as: maps, photographs, objects, art, sound, and film. METS is used to encapsulate descriptive metadata from varied schema such as Dublin Core, VRA Core, or locally-defined descriptive metadata. Structural metadata is also necessary for the organization of complex objects, according to the authors. METS is used ultimately to facilitate viewing of objects digital representations in a presentation tool called the METS Viewer. This project emphasizes the aggregative aspect of METS and how that is connected to dissemination of complex objects.

The ability of METS to accommodate multiple schemas into one record works well for projects that involve complex digital objects. Gibson (2011) identifies the capability of METS to aggregate the necessary information for complex digital objects with constituent parts that must be properly referenced for proper retrieval and viewing as a reason behind his election to utilize METS in the digitally-born Encyclopedia Virginia project. This project includes textual content as well as still and moving picture content. METS is able to accommodate the textual content using the TEI metadata standard, and the still and moving picture content using other metadata standards with METS serving as the wrapper for the record encapsulating all of the information. Additionally, Waters and Allen (2010) write about the usefulness of the MPEG family of encoding standards and METS in constructing records for complex musical objects. The authors

describe both MPEG-21 and METS as "content wrappers" for these objects. In comparison, they find that, "METS is more flexible than the hierarchical MPEG-21, but this flexibility adds complexity and makes it less intuitive" (p. 247). The authors describe the StrucMap as being useful in describing the various parts and divisions of a complex musical objects. This utilization of METS focusses on its ability to organize complex objects through its structural metadata subsection. And in a third instance of the use of METS to manage and disseminate complex digital objects, Nicholson (2006) writes about the appraisal of METS as the metadata schema to be used in the Europe-wide MoPark project originally designed for the Scotland park. The MoPark project was envisioned to create green tourism by allowing tourists to experience interpretive journeys in the Park delivered electronically through PDAs, mobile phones, audio tours, and talking posts. A project appraisal committee selected METS for the project over MPEG-21 and IMS-CP, utilized by the learning community. METS was selected because it was better developed than MPEG-21 and the MoPark project was eventually found to have only a weak connection to the learning community, making METS a superior choice to IMS-CP. The three instances of METS utilization associated with handling complex digital objects speaks to the flexibility of the METS schema.

The "METS Implementation Registry" page of the METS official website (The Library of Congress, 2013, August 13) includes a list of thirty-eight registered implementations of the METS schema. A useful table describes the institution and the project of each implementation. The table also includes a column describing project details including a description of the project, dates it was implemented (or is still being implemented), associated Internet site links, application profiles, external schema used with METS, associated documents and tools, and

project contact information. This webpage is useful in gaining an overview of the projects that have been, and are utilizing METS in some capacity. The details section that describes the project and the external schema used with METS is useful in gathering data that points toward the reasons for various project utilizations of METS. The information gathered from the table of the METS Implementation Registry will be used in combination with case studies and other literature describing the usage of METS in specific projects in order to examine trends in METS usage.

In conclusion, the literature illustrates that METS is a robust schema with a multitude of implementations that accommodate a variety of projects and the particular interests that each project encompasses. Cundiff (2004), Tennant (2004), and McDonough (2004) give us a history of the move towards an XML-based schema that could accommodate the demands of library materials and services that aging bibliographic standards and structures were not able to address. METS is the outcome of the efforts of the library community to address management, dissemination, and preservation needs related to digital objects, whether they are born digital or have been converted to digitized format, or are digital representations of physical objects.

The literature addresses interoperability and flexibility and how these two aspects of metadata usability play out in specific projects. The projects covered by the literature include a digital newspaper archive project, and a web site preservation project. There are six projects related to the transmission of complex digital object to digital repositories, three of which utilize tools compatible with METS in the process of depositing METS records into repositories.

Three projects specifically emphasize the importance of the ability of METS to reconstruct complex digital objects with multiple components through the use of its structural map

capabilities. The ability of METS to handle the organization aspect of complex objects has implications related to dissemination of digital content when it comes time for the data to be reconstructed and viewed by the end user. All three of the projects that emphasize the importance of METS handling of structural data, in addition to three other projects which emphasize the "wrapper" aspect of METS metadata, owe a debt to the way that METS utilizes its structural map for organization so that content can be located when software that is needed to view, or listen to content must be accessed.

The METS Implementation Registry provides a sample of the vast variety of uses project designers and implementers are finding for METS. This information, along with the information gathered from other projects in the literature review, will be useful in determining what the strongest criteria for METS implementation are.

Projects listed in the METS Implementation Registry, as well as projects described in the literature review section are used to provide data for analysis in answering the research questions: 1) Can it be said that METS is being selected for projects based primarily on one of two criteria: its flexibility or its interoperability?" And if this is the case: 2) Is one of these two attributes (flexibility or interoperability) selected for more than the other?

Methodology

A mixed-methods methodology was used in an effort to answer the research questions. All sources of data are secondary. Qualitative data in the form of descriptions of the reasons METS was selected for specific projects, or the perceived advantages of using METS for a specific project was taken from case studies described in the literature review section and from the "Project Details" section of the METS Implementation Registry Table on the Library of

Congress METS Official web site (Library of Congress, 2013, August 13). Data related to the reason(s) METS was selected for use in projects was entered into the METS Flexibility v. Interoperability Table (see Figure 1) for further analysis. Data on each project in the table was used to assign each project a value of 1 for either flexibility or interoperability, depending on which factor the project seemed to favor upon analysis. A value of 0 was entered for either flexibility or interoperability if it was not the favored factor. If neither flexibility nor interoperability could be determined as the primary factor for selecting METS for the project, a value of 1 was entered for both flexibility and interoperability. The use of these values allowed for a cluster analysis of flexibility versus interoperability with regard to the analyzed projects, the results of which are presented in METS Flexibility v. Interoperability Chart (see Figure 2).

Results

Figure 1

METS Flexibility v. Interoperability Data Table				
Project	***Reason for Using METS***	***Type***	***Interoperability***	***Flexibility***
Bankroft Library-Twain Papers Online	Archiving Managing/Storing Packaging	External	0	1
Berkeley Art Museum and Pacific Film Archive Digital Asset Management Database	Archiving Ingesting/Transmitting	External	1	0
Bibliographic Metadata Information System on Digital Architecture (S.I.M.B.A.D.) Biblioteca Digitale Provinciale P. Albino (Campobasso - Italy)	Archiving Ingesting/Transmitting Managing/Storing Packaging	External	1	1
Biblioteca Nacional -- National Library of Portugal	Archiving Managing/Storing Packaging Structuring	Internal	0	1
Brown University Library Center for Digital Initiatives	Ingesting/Transmitting Managing/Storing Packaging	Internal	0	1
California Digital Library Digital Preservation Group UC Libraries Digital Preservation Repository	Archiving Ingesting/Transmitting Managing/Storing	External	1	0
California Digital Library Publishing Group eScholarship Editions	Linking Managing/Storing Packaging Structuring	Internal	0	1
California Digital Library Digital Special Collections Online Archive of California Calisphere	Archiving Ingesting/Transmitting Managing/Storing	External	1	0

Chinese Ministry of Education Chinese Digital Museum Project	Archiving Ingesting/Transmitting Linking Managing/Storing	External	1	1
Culturnet Cymru Books From the Past	Linking Managing/Storin Packaging Structuring	Internal	0	1
Deutsche Nationalbibliothek -- German National Librarykopal - Co-operative Development of a Long-Term Digital Information Archive	ArchivingIngesting/Transmitting Managing/Storing	External	1	0
Encyclopedia Virginia Project	Linking Managing/Storing Packaging Structuring	Internal	0	1
Florida Center for Library AutomationContent Management System /Digital Object Repository	Ingesting/Transmitting Managing/Storing	External	1	0
Goettinger Digitalisierungs -Zentrum Retrospective Digitization, Goettingen State and University Library	Archiving Managing/Storing	Internal	0	1
Harvard University Harvard University Library Asynchronous delivery of biomedical image stacks	Linking Managing/Storing Structuring	Internal	0	1
Harvard University Harvard University Library Preservation Audio	Linking Managing/Storing Packaging Structuring	Internal	0	1

Harvard University Harvard University Library Page-turned Objects	Linking Managing/Storing Structuring	Internal	0	1
Indiana University Digital Library Program Online delivery of multi-page objects	Linking Managing/Storing Structuring	Internal	0	1
Indiana University Digital Library Program Sound Directions	Archiving Ingesting/Transmitting	External	1	0
Indiana University Digital Library Program Ethnomusicological Video for Instruction and Analysis Digital Archive (EVIADA)	Archiving Ingesting/Transmitting Managing/Storing Packaging Structuring	External	1	1
Library of Congress Audio-Visual Prototyping Project	Archiving Ingesting/Transmitting	External	1	0
Library of Congress The Library of Congress Presents... Music, Theater, and Dance	Managing/Storing Packaging	Internal	0	1
Llyfrgell Genedlaethol Cymru/ National Library of WalesY Drych Digidol / The Digital Mirror	LinkingManaging/StoringPackagingStructuring	Internal	0	1
MINERVA	Archiving Ingesting/Transmitting Managing/Storing Packaging	External	1	0
Ministry of Culture, Spain Biblioteca Virtual de Prensa Historica/ Virtual Library of Historical Press	Archiving Ingesting/Transmitting Managing/Storing	External	1	0

Ministry of Culture, Spain Biblioteca Virtual del Patrimonio Bibliográfico / Virtual Library of Bibliographic Heritage	Ingesting/Transmitting Linking Managing/Storing Packaging Structuring	External	1	0
MIT DSPACE	Archiving Ingesting/Transmitting Managing/Storing Packaging	External	1	0
MoPark	Linking Managing/Storing Packaging Structuring	Internal	0	1
NDNP	Archiving Ingesting/Transmitting Linking Managing/Storing Packaging Structuring	External	1	1
OCLC Digital Archive Implementation	Archiving Ingesting/Transmitting Managing/Storing Packaging	External	1	0
Oxford University Oxford Digital Library	Managing/Storing	Internal	0	1
PERSEE Portail de Revues Scientifiques en Sciences Humaines et Sociales	Managing/Storing Structuring	Internal	0	1
RLG RCM Intiative	LinkingManaging/StoringStructuring	Internal	0	1

University of Alberta Peel's Prairie Provinces Project	Archiving Ingesting/Transmitting Managing/Storing Packaging	External	1	0
University of California, Berkeley The University Library Archival Collections	Archiving Ingesting/Transmitting	External	1	0
University of California, Berkeley The University Library Stored Materials and Obscure Materials: Tables of Contents	Managing/Storing Packaging Structuring	Internal	0	1
University of California, Berkeley The University Library Repository of CS Tech Reports with OAI interface	Archiving Ingesting/Transmitting Packaging	External	1	0
University of California, San Diego Libraries Digital Asset Management System	Archiving Ingesting/Transmitting Managing/Storing	External	1	0
University of Chicago University of Chicago Library Digital Collections	Archiving Managing/Storing	Internal	0	1
UC Boulder	Linking, Managing/Storing Packaging Structuring	Internal	0	1
University of Graz, Austria Austrian Literature Online	Ingesting/Transmitting Managing/Storing	External	1	0
UHDL	Archiving Ingesting/Transmitting Managing/Storing Packaging	External	1	1
University of Michigan Mbooks	Linking Managing/Storing Structuring	Internal	0	1

UWA	Archiving Ingesting/Transmitting Packaging	External	1	0

Each project was classified by type as either "Internal" or "External." External projects are projects designed around sharing of digitized resources between different institutions or the sharing of objects through a centralized repository. Internal projects are projects designed using METS as a container for complex digital objects that make use of structural metadata in order to reconstruct the object for presentation. This type of object sometimes accesses external files in order to present the object. An example of this type of object is an eBook which must establish the order of pages for proper presentation through structural metadata.

The following recurring criteria were found in descriptions of the analyzed projects and were determined to be important considerations in selecting METS for use in them.

- Archiving-METS used as schema for preservation of object records
- Ingesting/Transmitting-METS SIP packaging used for ingestion or transmission of records between repositories
- Linking-METS structural metadata used for linking to externally stored objects
- Managing/Storing-METS used as metadata schema for storage in repository
- Packaging-METS used as "wrapper" for records that make use of multiple schemas
- Structuring-METS structural metadata used for reassembly of complex digital objects

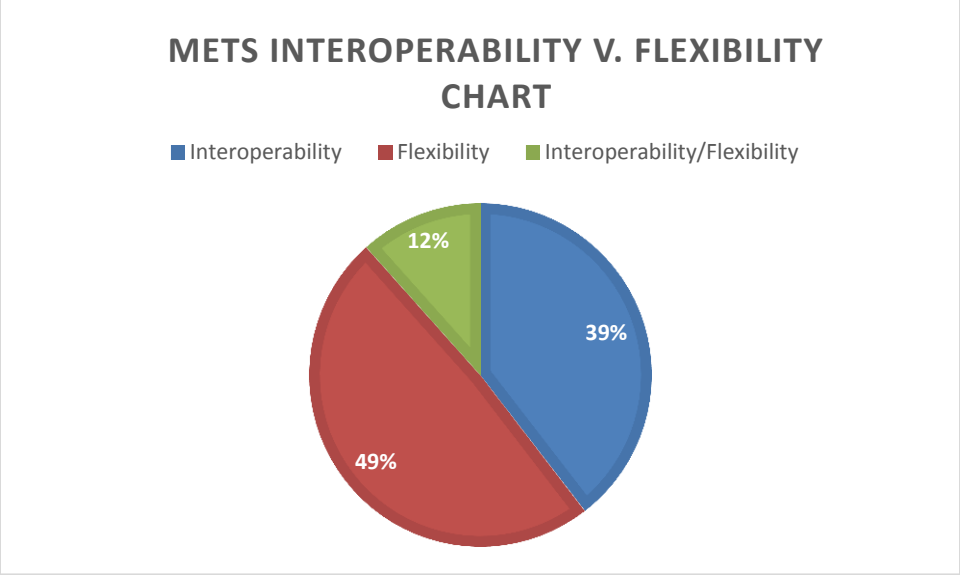
When these criteria were mentioned in a case study of a project or in the "Project Details" section of its entry in the METS Implementation Registry Table from the METS Official Web Site (Library of Congress, 2013, August 13), they were listed in the "Reasons for using METS"

sec

tion of the METS Flexibility v. Interoperability Data Table (see Figure 1). Each of the following terms: Archiving, Ingesting/Transmitting, Linking, Managing/Storing, Packaging, Structuring constitutes a reason for selecting METS for a project. External projects reflected reasons for using METS associated with Archiving and Ingesting/Transmitting, which correlates with interoperability. These projects were given a value of 1 in the interoperability column. Internal projects reflected reasons related to Linking, Packaging, and Structuring, and were strongly correlated with flexibility. These projects were given a value of 1 in the flexibility column. Management/Storing occurred often with both External and Internal project types. There were five instances in which it could not be determined whether the primary reason for use of METS was flexibility or interoperability. In these cases the projects were given a value of 1 in both the flexibility and in the interoperability column. The flexibility and interoperability statistics produced the following clusters of data for flexibility, interoperability, and flexibility/interoperability:

Figure 2

METS Interoperability v. Flexibility Table	
Interoperability	17
Flexibility	21
Interoperability/Flexibility	5



Discussion

The data shows that both flexibility and interoperability are significant primary concerns for projects that make use of the METS metadata schema. The idea that METS is selected for use due to its flexibility or due to its interoperability, with either flexibility or interoperability being the primary determining factor depending upon the type of project, does seem to be supported by

the data. The pie chart shows three distinct usage clusters, with the largest two describing either projects that use METS due to its flexibility or projects that use METS due to its interoperability. There was a smaller cluster where it could not be determined whether flexibility or interoperability was more important to the project designers. It is important to note that all of these projects classified as Interoperability/Flexibility were of the External type. It may be that the flexibility of METS in its ability to accommodate other schemas is also important to digital repository projects in the areas of access or preservation. It is also important to note that only projects that appear in the METS Implementation Registry and in the case studies mentioned in the literature review section were a part of the data pool. It is unclear whether or not this pool of data is representative enough of projects that make use of METS worldwide to make a general statement regarding whether METS is used more for it flexibility or for its interoperability.

Conclusion

METS is a versatile metadata schema that is useful in a variety of contexts both for its flexibility and for its interoperability. Although there are aspects of both in most implementations, this study indicates that flexibility has a slight edge over interoperability in the various projects analyzed. And the fact that projects could be separated into External and Internal types, external seeming to favor interoperability, and internal seeming to favor flexibility does seem to point towards the tradeoff discussed by McDonough (2004) where flexibility sacrifices some interoperability when using METS.

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