DigCCurr - Preserving Access to Our Digital Future: Building an International Digital Curation Curriculum

Title: High-Level Categories of Digital Curation Functions
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Category	Definition/Explanation	First-Level Sub-Functions
1. Systems Engineering and Development[a]	"Systems engineering provides the systems analysis and development work necessary for IT infrastructure development. It also lends technical assistance to…activities surrounding the acquisition, development, and deployment of advanced IT and communications systems."[1]	• Analysis[2] • Coding, testing and implementation[3] • Database analysis[4] • Database design and specification[5] • Design[6] • Interface design[7] • Operation and maintenance[8] • Requirements Definition[9] • Specification[10]
2. Production[11]	Creation of digital objects, either directly or through digitization of analog materials.	• Assign to management class[12] • Ensure production is authorized and ethically sound[13] • Fix to medium[14] • Generate digital content[15]
3. Selection, Appraisal and Disposition[16]	Processes associated with determining what subsets of all possible digital information should be kept, how long they should be kept, and where they should be kept. This includes disposition, which is the determination that, at a particular time or upon the occurrence of a particular event, a digital object or set of digital objects should be either (1) removed out of an operational system and into another one, or (2) destroyed.	• Deselection[17] • Enact selection, appraisal or disposition[18] • Evaluation and monitoring of collections[19] • Identify needs[20] • Identify valuable information resources[21] • Make selection, appraisal or disposition decision[22] • Selection/collection policy development[23]
4. Identifying, Locating and Harvesting[24]		• Extracting identifier information to determine network location of resource

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[a] The sub-functions are often presented as a serialized set of stages (as in the waterfall development model). While some sub-functions naturally follow from others, we are not assuming any particular development methodology. One could iterate through the sub-functions in whatever order and as many times as the organization deems necessary.

		• Harvesting metadata from an external source or repository[25] • Making request to appropriate location to collect resource • Defining and setting parameters for harvests and file requests[26] • Synchronize content
5. Transfer[27]	Moving data from one environment into another	• Getting[28] • Putting[29] • Detachment[30]
6. Ingest[b31]		• Assigning preservation levels[32] • Commit AIP to archive[33] • Coordinate updates[34] • Generating AIP[35] • Match content with rules and agreements[36] • Providing feedback to Producer[37] • Receive submission[38] • Scheduling items in queue to be ingested[39]
7. Data Management[40]		• Administer Database[41] • Generate Report[42] • Linking/resolution services[43] • Perform Queries[44] • Receive Database Updates[45]
8. Description, Organization and Intellectual Control[c46]	Development, capture and management of descriptive information (DI), preservation description information (PDI) and packaging information (PI) associated with AIPs.[d]	• Analyze existing DI, PDI and PI, and determine needs for DI, PDI and PI[e47] • Assign unique, persistent identifiers[f48] • Creation and capture of DI and PDI[g49] • Creation and capture of PI[h] • Creation and maintenance of representation information registry[50] • Creation and maintenance of producer profiles[51] • Creation and maintenance of policy/rule registries[52] • Creation and maintenance of tools registry and tools service[53] • Establish plan and conventions for DI, PDI and PI[54] • Subject analysis • Visualization[55]

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[b] The main conceptual boundary between Transfer and Ingest is: getting an object into the archives environment generally, which can include a staging area (Transfer), and the formal incorporation of the object as part of an AIP into the Archive (Ingest).

[c] The OAIS places "Add Descriptive Information" under Ingest. However, we have broken out description as its own function, in order to recognize that it can be done at many points in the information lifecycle. It is not only a part of the ingest process.

[d] This is at a higher level of abstraction than both Data Management and Archival Storage. It ensures that the data associated with Content Information that is addressed in Data Management, Archival Storage and Access is sufficiently detailed, complete, and accurate. Note that Representation Information is considered part of the Content Information, and it is addressed primarily in Preservation Planning and Implementation below.

[e] This can happen at any time in the lifecycle. However, when the analysis is carried out while the materials are still in their creation environment, there is substantial overlap with: 20. Analysis and Evaluation of Producer Information Environments.

[f] See also the Linking/resolution service in Data Management, which ensures that object identifiers can always be resolved to specific locations in storage.

[g] This includes both what the OAIS calls Preservation Description Information and Associated Description.

[h] According to the OAIS, "The Packaging Information is that information which, either actually or logically, binds, identifies and relates the Content Information and PDI." (2-6) We have broken this out as a separate sub-function, because establishing and managing PI involves a set of activities that are quite distinct from establishing and managing DI and PDI.

		• Versioning[56]
9. Archival Storage[57]	Services and functions used for the storage and retrieval of Archival Information Packages	• Disaster planning, preparation and response[58] • Ensuring sufficient redundancy of copies • Error checking[59] • Holdings maintenance[60] • Management of storage hierarchy[61] • Providing data[62] • Receive data[63] • Replacement of media[64]
10. Management[65]	Activities of the actor(s) who sets overall Archive mandate, policy and resources as one component in a broader domain of activity.	• Creation or approval of repository service definition[66] • Definition or approval of archives mission, objectives and goals[67] • Definition or approval of high-level policies[68] • Fund raising[69] • Mandate and guidance for resource utilization[70]
11. Administration[71]	Services and functions needed to control the operation of the other functional entities on a day-to-day basis.	• Activation of requests[72] • Archival information update[73] • Assign responsibilities[i] • Budgeting and resource allocation[74] • Communications[75] • Customer service[j76] • Deliberation process[77] • Establishing standards, policies and rules[k78] • Facilities management and planning[79] • Human resource management[80] • Implementing and enforcing standards, policies and rules[81] • Leadership[l82] • Management of system configuration[83] • Management of and response to challenges or complaints[84] • Managing relationships between Administration and Management[85] • Monitoring and proof of compliance with standards, policies and rules[86] • Monitor changes in warrant[m87]

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[i] This related to, but distinct from, human resources activities that ensure that the right people have been hired for particular jobs. Assign responsibilities is a more high-level function that ensures all tasks have been assigned to someone and to the right types of individuals or groups (e.g. those with appropriate credentials, job rank, security clearances).

[j] This is very similar to what other literature calls "Customer Relationship Management," which is the capture, management and effective use of information about customers and their interactions with the organization in question. This function does not include activities otherwise addressed in the following three other functions: Communication; Reference and User Support Services; Monitor Designated Community.

[k] This relates to internal standards and conventions. Participation in broader standards development falls under 19. Advocacy and Outreach.

[l] Defined as "Taking iniiatiative, making things happen through the effective action of others" [Mahmoodi, 1991], leadership can be enacted in the process of carrying out various functions. However, it also includes some distinct activities that warrant their own category.

[m] This is analogous to Monitor Technology and Monitor Designated Community. However, the target of monitoring is the set of requirements (either within the archival institution or the larger environment) that pertain to the archive. For example, a change in FOIA within the U.S. will imply changes to many parts of the archive's operations. The concept of "warrant" comes from the Pittsburgh project to define the functional requirements for evidence in recordkeeping. See: Duff, Wendy. "Harnessing the Power of Warrant." *American Archivist* 61 (1998): 88-105.

		• Planning[88] • Project management[89] • Review and update of standards, policies and rules[90] • Organizational change management[91] • Risk management[92] • Security[93] • Statistical analysis to support operations[94]
12. Preservation Planning and Implementation[95]		• Develop packaging designs and migration plans[96] • Develop preservation strategies and standards[97] • Monitor designated community[98] • Monitor technology[99] • Define significant properties to preserve[100] • Reconciling preservation requirements with preservation capabilities[101]
13. Access[102]		• Coordination of access activities[103] • Delivery of responses[104] • Exposure[105] • Generation of access collections[n106] • Generation of DIP[o107] • Information discovery • Information retrieval • Legal discovery
14. Use, Reuse and Adding Value to Accessed Information[p108]	Users acting upon information objects or packages (including after they have received DIPs). The archive may provide support for use, such as tools that allow client-side visualization of data sets. Users may also provide value-added information (e.g. annotations or tagging), which the archives then Ingests into the archive.	
15. Reference and User Support Services[109]		• Developing policies for reference services[110] • Facilitating access to useful and appropriate digital objects[111] • Help desk and end user technical support • Providing associated information to consumers[112]

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[n] This sub-function involves the aggregation of potential DIPs or resources for generating potential DIPs. It includes many aspects of information architecture. In contrast to "Description, Organization and Intellectual Control" above, this sub-function relates specifically to how information is labeled, brought together and presented within particular access environments.

[o] In our functional breakdown, processing and creating derivative digital objects is part of "Transformation of digital objects/packages" not Access.

[p] Much of the value added by a user can be incorporated into the Description function (e.g. user annotations, user tagging of content). However, users can also add services that are incorporated into other functions.

16. Common Services[q][113]	The services necessary to support the archive.	• Network services[114] • Operating system services[115] • Security services[116]
17. Destruction and Removal[117]		• Destruction[118]
18. Collaboration, Coordination and Contracting with External Actors[119]		• Conflict resolution involving Producers, Consumers and Archives[120] • Establishment of succession, contingency or escrow arrangements with external actors[121] • Identifying, establishing and coordinating specific types of collaborative relationships with other Archives • Management of agreements[122] • Negotiation and maintenance of effective relations with external actors[123] • Sourcing[124]
19. Advocacy and Outreach[125]	Activities aimed at influencing systems or behavior outside of the Archive.	• Standards development[r] • Negotiation for resources[126] • Outreach and public programming[127] • Understanding and promoting Archive's role within the larger institutional context[128] • Engagement with local community[129]
20. Analysis and Evaluation of Producer Information Environment[s]	This is often done in relation to known benchmarks or standards. It includes assessments of recordkeeping systems and authenticity of documents within those systems. It can also include the analysis of work practices within the producer environment. Focus can be at level of organization/institution, information system (e.g. recordkeeping system), collection, or individual items.	• Assessment of business activity[130] • Assessment of existing systems[131] • Identification of digital curation requirements in production environment[132] • Preliminary Investigation
21. Analysis and Characterization of Digital Objects/Packages[133]		• Characterization of digital objects within information package[134] • Characterization of information package

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[q] Common Services plays a unique role both within the OAIS and within this taxonomy of functions. It includes a set of underlying technical services that are necessary for successful digital curation but are carried out by someone else (not directly by a digital curation professional). It is very important for digital curators to be aware – at least at a basic level -- of what the Common Services are, how they relate to each other, and some of the most viable ways for them to be provided. (e.g. in order to evaluate, supervise and contract for the services). However, Common Services are assumed, by definition, to fall outside the direct purview of digital curation. Whenever it would be important for a digital curator to know how to actually carry out or provide a service him/herself, it should be elaborated in one of the other functions within this taxonomy. Note that all of the common services are addressed in detail in 5.2. Characteristics of Technologies, which is part of the Prerequisite Knowledge dimension of the DigCCurr "Matrix of Topics for Digital Curation Curriculum."

[r] This is engaging in standards development efforts with other organizations - e.g. within a consortium or standards development organization (SDO) - as opposed to setting of internal standards, which is part of Management or Administration.

[s] This function addresses analysis and evaluating of the current Producer information environment. This function and its sub-functions are strongly influenced by the DIRKS (Designing and Implementing Record Keeping Systems) methodology. Efforts to change or influence that environment are addressed in Advocacy and Outreach above.

22. Validation and Quality Control of Digital Objects/Packages[135]	Identify component parts and ensure everything expected is present (e.g. compare to included definition file, "packing list," negotiated agreement, selection criteria)	• Bitstream[136] • Check for viruses[137] • Digital Object[138] • Digital Object Components[139] • Information Package[140]
23. Transformation of Digital Objects/Packages[141]		
24. Purchasing and Managing Licenses to Resources[142]		• Establish archives intellectual property rights in support of preservation actions on digital objects[143]

Meta-Level Functions (functions to be applied to any of the functions listed above)

25. Analysis and Documentation of Curation Functions[144]		• Monitoring and logging[145] • Process mapping[146]
26. Evaluation and Audit of Curation Functions[147]		• Certification of the archive
27. Research and Development to Support Curation Functions		• Research methods[148] • Supporting and administering research and development[149] • Business process identification and analysis • User needs analysis and usability assessment[150]
28. Education and Sharing of Expertise or Guidance on Curation Functions[151]		

Sources and Related References:

[1] ERA Program Management Information. U.S. National Archives and Records Administration. http://www.archives.gov/era/program-mgmt.html (accessed September 30, 2007)

[2] Kock, Ned F. Systems Analysis & Design Fundamentals: A Business Process Redesign Approach. Thousand Oaks, CA: Sage Publications, 2007.

[3] Kock, 2007

[4] Kock, 2007

[5] Kock, 2007

[6] Kock, 2007

[7] See also 6-d: Interaction design, info summarization and visualization, usability assessment. Collaborative Research: Curriculum Development: Digital Libraries. September 16, 2007. http://curric.dlib.vt.edu/DLcurric_images/ModuleFramework.2007-09-16.pdf [UNC-VT]

[8] Kock, 2007

[9] Kock, 2007.

[10] Kock, 2007

[11] "Produce" in "LC Process Descriptions for the Digital Life Cycle." Library of Congress, 2003; "creation" in Anderson, Sheila, Mike Pringle, Mick Eadie, Tony Austin, Andrew Wilson, and Malcolm Polfreman. "Digital Images Archiving Study." Arts and Humanities Data Service, 2006. [See especially p.94-99]. For a breakdown of the production process in science, see Arovelius, Renata, and Juliane Mikoletzky. "Archives of Science: An International Perspective and Comparison on Best Practices for Handling of Scientific Records." Paper presented at the Fifteenth International Congress on Archives, Vienna, Austria, August 23-29, 2004.

[12] Adapted from "LC Process Descriptions" – "Assign to access management class"; for more general functions of assigning to a collection (classification), see also Cornwell Affiliates. "Model Requirements for the Management of Electronic Records." Interchange of Data between Administrations (IDA) Programme of the European Commission, 2001 [currently undergoing revision].

[13] On creation of electronic records that is authorized, see ISO 15489; on obtaining informed consent for production of digital objects that include personally identifying or otherwise sensitive data, see MacNeil, Heather. *Without Consent: The Ethics of Disclosing Personal Information in Public Archives*. Chicago, IL: Society of American Archivists and Scarecrow Press, 1992.

[14] "LC Process Descriptions"

[15] Adapted from "LC Process Descriptions"; see also "Module 3-b: Digitization" in Modules Framework. Collaborative Research: Curriculum Development: Digital Libraries. September 16, 2007. http://curric.dlib.vt.edu/DLcurric_images/ModuleFramework.2007-09-16.pdf [UNC-VT]

[16] See also Select Electronic Records [InterPARES]; "Disposition authorities that govern the removal of records from operational systems should be applied to records on a systematic and routine basis."[ISO 15489]

[17] Evans, G. Edward, and Margaret Zarnosky Saponaro."Deselection." In *Developing Library and Information Center Collections*, 49-68. Fifth Edition ed, Library and Information Science Text Series. Westport, CT: Libraries Unlimited, 2005.
 See also "reappraisal" in Daniels-Howell, Todd. "Reappraisal of Congressional Papers at the Minnesota Historical Society: A Case Study." *Archival Issues* 23 (1998): 35-40;

[18] See also Carry out Disposition of Electronic Records [InterPARES]; Implementing Disposition [ISO 15489-1:2001, p.19]

[19] See also Monitor Appraised Electronic Records [InterPARES]; "Evaluation" in Evans and Saponaro, 2005.

[20] See also "Information Needs Assessment" and "" in Evans and Saponaro, 2005.

[21] See also Compile Information about Electronic Records [InterPARES]; Appraise Electronic Records [InterPARES]; Assess Value of Electronic Records [InterPARES]; Determine Value of Electronic Records [InterPARES]; Determine the Record Elements to be Preserved [InterPARES]; Identify the Digital Components to Preserve [InterPARES]; B1.1 Repository identifies properties it will preserve for each class of digital object. [Audit Checklist]

[22] This includes establishment of operational selection criteria, e.g. content, extent and timing/frequency (Brown, Adrian. *Archiving Websites: A Practical Guide for Information Management Professionals*. London: Facet, 2006, p.33-39); see also Make Appraisal Decision [InterPARES]; "Selection Process in Practice" in Evans and Saponaro, 2005.

[23] See also Anderson, Joanne S., ed. *Guide for Written Collection Policy Statements*. Chicago, IL: American Library Association, 1996; 3-a: Collection development/selection policies [UNC-VT].

[24] List of sub-functions is adapted from Sompel, Herbert Van de, Michael L. Nelson, Carl Lagoze, and Simeon Warner. "Resource Harvesting within the OAI-PMH Framework." *D-Lib Magazine* 10, no. 12 (2004). See also Brown (2006), who presents several collecting methods: Direct Transfer (see transfer below), database archiving, remote harvesting, and transactional archiving (p.46). See also 3-c: Harvesting [UNC-VT].

[25] See also 4-b: Metadata, cataloging, metadata markup, metadata harvesting [UNC-VT]

[26] See also "Crawl Settings" and "Collection Settings" in Brown, 2006 (54-56).

[27] See also Delivery and Capture [NEDLIB]

[28] Get [NDIIPP Life Cycle]; see also "Direct transfer" in Brown, Adrian. *Archiving Websites: A Practical Guide for Information Management Professionals*. London: Facet, 2006 (p.46-50). See also B1.4 Repository has a process to ensure that the information is acquired from the expected source. [Audit Checklist]. Several sub-functions presented in Owens, Evan, Suku Sukumar, John Meyer, David Copperman, and Roland Mesde. "Portico Technical Overview: A Format-Registry-Based Automated Workflow for the Ingest and Preservation of Electronic Journals." Paper presented at the NDIIPP Partners Meeting, Berkeley, California, November 2005; Schrenk, Michael. Webbots*, Spiders, and Screen Scrapers: A Guide to Developing Internet Agents with PHP/CURL*. San Francisco, CA: No Starch Press, 2007. [See especially: Downloading Web Pages - http://www.nostarch.com/download/webbots_ch3.pdf].

[29] Put [Pathways Core]. For sources related to sub-functions, see also B1.3 Repository has an identifiable, written definition for each SIP or class of information ingested by the repository. [Audit Checklist]; Prepare Electronic Records for Transfer [InterPARES].

[30] Rödig, Peter, Uwe M. Borghoff, Jan Scheffczyk, and Lothar Schmitz. "Preservation of Digital Publications: An OAIS Extension and Implementation." Paper presented at the ACM symposium on Document engineering, Grenoble, France, 20-22 November 2003. See also Brezinski, Dominique, and Tom Killalea. "Guidelines for Evidence Collection and Archiving." Request for Comments 3227. 2002; Farmer, Dan, and Wietse Venema. *Forensic Discovery*: Upper Saddle River, NJ: Addison-Wesley, 2005; Jones, Keith J., Richard Bejtlich, Curtis W. Rose, Dan Farmer, Wietse Venema, and Brian Carrier. *Computer Forensics Library Boxed Set*: Addison-Wesley, 2007; Ross, Seamus, and Ann Gow. "Digital Archaeology: Rescuing Neglected and Damaged Data Resources." London: British Library, 1999; Underwood, William E. "The Presidential Electronic Records Pilot System: Results of Laboratory Experiments and Use by Archivists." Georgia Tech Research Institute, 2003; Entlich, Richard, and Ellie Buckley. "Digging up Bits of the Past: Hands-on with Obsolescence." *RLG DigiNews* 10, no. 5 (2006); Balkestein, Marjan, and Heiko Tjalsma. "The ADA Approach: Retro-Archiving Data in an Academic Environment." *Archival Science* 7, no. 1 (2007): 89-105..

[31] Reference Model for an Open Archival Information System (OAIS). Washington: Consultative Committee for Space Data Systems, 2002.

[32] Adapted from Assigning preservation levels based on policies [Portico]; see also Check Format and Preservation Level [Portico].

[33] See also Load into Archive [Portico]; B1.9 Repository can demonstrate when preservation responsibility is formally accepted for the contents of the SIP. [Audit Checklist]; Part B6: Formally Accession, Glick, Kevin, and Eliot Wilczek. "Ingest Guide." Tufts University and Yale University, 2006 [Ingest Guide].

[34] OAIS.

[35] OAIS. See also B1.5. Verification, analysis and creation of metadata. [Audit Checklist]

[36] Adapted from Match content with contracts (agreements) [Portico]; see also Check Agreement ID [Portico].

[37] See also B1.7 Repository provides Producer/depositor with appropriate responses at predefined points during the ingest processes. [Audit Checklist]; Acknowledge receipt [NDIIPP Life Cycle].

[38] OAIS.

[39] Adapted from [Portico].

[40] OAIS.

[41] OAIS.

[42] OAIS.

[43] [Audit Checklist] B2.4. See also B2.5 If unique identifiers are associated with SIPS before ingest, they are preserved in a way that maintains a persistent association with the resultant AIP. [Audit Checklist]; Part A6: Assess Identifier Rules [Ingest Guide]

[44] OAIS.

[45] OAIS.

[46] See also Module 4: Info / Knowledge Organization (includes 4-a: Information architecture (e.g., hypertext, hypermedia); 4-b: Metadata, cataloging, metadata markup, metadata harvesting; 4-c: Ontologies, classification, categorization; 4-d: Subject description, vocabulary control, thesauri, terminologies; 4-e: Object description and organization for a specific domain); 7-a: Search engines, IR, indexing methods [UNC-VT]; Compile Evidence Supporting the Presumption of Authenticity [InterPARES]; Generate Descriptive Information [OAIS] (Part of Ingest); "Information structuring and architecture" in Abell, Angela. "Skills for Knowledge Environments." *Information Management Journal* 34, no. 3 (2000): 33-38, 40, 41; Generate Descriptive Metadata [Portico]; Generate Technical Metadata [Portico].

[47] See "Analyze the existing arrangement and description of records and papers and make decisions about any further arrangement and description that may be necessary." Handbook for Certified Archivists. Albany, NY: Academy of Certified Archivists. 2006. [ACA]

[48] See also Hilse, Hans-Werner, and Jochen Kothe. Implementing Persistent Identifiers: Overview of Concepts, Guidelines and Recommendations. London: Consortium of European Research Libraries, 2006. http://nbn-resolving.de/urn:nbn:de:gbv:7-isbn-90-6984-508-3-8; Campbell, Douglas. "Identifying the Identifiers." Paper presented at the International Conference on Dublin Core and Metadata Applications, Singapore, August 27-31, 2007. http://www.dcmipubs.org/ojs/index.php/pubs/article/viewFile/34/16; Brown, Adrian. "The PRONOM PUID Scheme: A scheme of persistent unique identifiers for representation information." The National Archives (UK), 2006. http://www.nationalarchives.gov.uk/aboutapps/pronom/pdf/pronom_unique_identifier_scheme.pdf

[49] See also-d: Document and e-publishing/presentation markup; 6-d: Interaction design, info summarization and visualization, usability assessment [UNC-VT]; Stein, Adelheit. "Collaboratory for Annotation, Indexing and Retrieval of Digitized Historical Archive Material: COLLATE." European Commission, 2004. For PDI, see especially PREMIS and PorticoMETS.

[50] See also Abrams, Stephen L. "Establishing a Global Digital Format Registry." *Library Trends* 54, no. 1 (2005): 125-43; Abrams, Stephen L. "The Role of Format in Digital Preservation." *VINE* 34, no. 2 (2004): 49-55.

[51] [Portico].

[52] Adapted from [Portico]. See also Smith, MacKenzie, and Reagan W. Moore. "Digital Archive Policies and Trusted Digital Repositories." The *International Journal of Digital Curation* 2, no. 1 (2007): 92-101.

[53] Adapted from [Portico].

[54] See "Design and implement an arrangement plan to either perfect the existing arrangement or establish a new one."; "Design and implement a descriptive plan to identify and explain the structure, context and content of records and papers to promote their accessibility." [ACA]

[55] See also 6-d: Interaction design, info summarization and visualization, usability assessment [UNC-VT].

[56] See also "Where multiple versions of a document may be stored, a policy is required which ensures that all relevant versions are stored, and their relationships maintained." Electronic imaging -- Information stored electronically -- Recommendations for trustworthiness and reliability. ISO/TR 15801:2004.

[57] OAIS.

[58] For a detailed breakdown of sub-functions, see dPlan: The Online Disaster-Planning Tool. https://www.dplan.org/. See also Conway, 1990; Stephens, David O. "Protecting Information from Disaster." *Records Management: Making the Transition from Paper to Electronic*, 161-178. Lenexa, KS: ARMA, 2007.

[59] OAIS.

[60] U.S. National Archives and Records Administration - http://www.archives.gov/preservation/holdings-maintenance/. For a breakdown and discussion of related sub-functions, see Conway, Paul. "Facts and Frameworks: An Approach to Studying the Users of Archives." *American Archivist* 49 (1986): 393-407. See also Physical Access Control (part of Administration) [OAIS] - "The Physical Access Control function provides mechanisms to restrict or allow physical access (doors, locks, guards) to elements of the archive, as determined by archive policies."

[61] Adapted from OAIS. See also "The organization should have policies regarding the use of specific types of media for different informaiton storage requirements (e.g. access requirements, retention periods, and security requirements." [ISO 15801].

[62] Adapted from OAIS.

[63] OAIS.

[64] Adapted from OAIS.

[65] OAIS. See also 9. Management and Evaluation [UNC-VT].

[66] For concept and discussion of "service definition" within the context of a digital repository, see Barton, Mary R., and Margaret M. Waters. "Creating an Institutional Repository: LEADIRS Workbook." Cambridge, MA: MIT Libraries, 2005. http://hdl.handle.net/1721.1/26698

[67] See also Project management [Abell, 2000]; Module 9-a: Project Management [UNC/VT Digital Library Curriculum]; A1.1 Repository has a mission statement that reflects a commitment to the long-term retention of, management of, and access to digital information on behalf of depositors. [Audit Checklist]; "Develops and communicates mission, roles, and functions of the library." [Mahmoodi, 1991]

[68] See also and "Determines, or at least endorse, pricing policies, as applicable, for OAIS services." [OAIS]

[69] For discussion of fundraising approaches and sub-functions, see Finch, Elsie T. Freeman, ed. *Advocating Archives: An Introduction to Public Relations for Archivists*. Metuchen, NJ: SAA and Scarecrow Press, 1994; Cassarchis, Cathrin. "An Introduction to Fundraising for Archives." National Council on Archives, 1999. http://www.ncaonline.org.uk/materials/fundraising.pdf. See also A4.5 Repository recognizes the eventual strong possibility of a gap between repository-generated funding and the funding necessary to meet the repository's commitments to its depositors. It commits to bridging these gaps by securing funding and resource commitments specifically for that purpose; these commitments can come either from the repository itself or parent organizations, as applicable. [Audit Checklist]; "Understands the resources available via state, national and international library networks."; Fund Raising Skills; "Has effective public relations skills to actively pursue funding." "Be involved in fundraising efforts and in exploring alternate funding sources." "Develops and writes proposals for state, local, federal and private funds." [Mahmoodi, 1991].

[70] See also "Provide guidelines for resource utilization (personnel, equipment, facilities)" [OAIS]

[71] OAIS. See also 9. Management and Evaluation [UNC-VT]; "Develops strategies, tasks, and schedules to meet goals and objectives."; "Sets organizational priorities."; "Selects management structure appropriate to the activity." "Organize library into operational units" [Mahmoodi, 1991]; Part 1 - Management Principles and the Records and Information Management (RIM) Program. Main functions defined as: planning, organizing, directing, controlling, staffing [ICRM]; "Program management leads the acquisition, development, and deployment of an ERA system that provides the capability for preservation, management, and sustained access to electronic records." [ERA Functional Area].

[72] Adapted from OAIS.

[73] OAIS.

[74] See also "Understands taxing and funding for public libraries."; "Prepares a budget to implement the goals and objectives of an organization."; "Allocates resources (material, financial, personnel)." "Fiscal management"; "Prepare budgets: annual, operating, facilities"; LIFE and Espida projects; "Uses cost analysis techniques" and "Monitor and control expenditures" [Mahmoodi, 1991]; 9-f: Cost/economic issues [UNC-VT];

[75] [ERA Functional Area] See also "Informs others of decisions, changes, and other relevant information in a timely fashion." "Speaks effectively one-to-one, within groups, and in presentations to groups." ""Be responsible for reports to various governmental units"" [Mahmoodi, 1991]

[76] OAIS.

[77] See also Part 1, A.3. Decision-Making [ICRM]

[78] Adapted from "Establish Standards and Policies" [OAIS]. See also "Develops and communicates written policies," and "Integrates external policies and administrative regulations, e.g. A.D.A., civil service" [Mahmoodi, 1991]

[79] See also "Direct facilities projects and building programs"; "Plan and coordinate maintenance and improvement of library facilities and property" [Mahmoodi, 1991]; Wilsted, Thomas P. *Planning New and Remodeled Archival Facilities*. Chicago, IL: Society of American Archivists, 2007.

[80] Several sub-functions are derived from [Audit Checklist], [Mahmoodi, 1991], and [Finch, 1994]. See also "Develops and administers personnel policies and procedures."; "Interprets local, state and national laws and regulations concerning personnel, e.g., workers compensation, equal employment opportunity, social security, retirement plans." "Personnel management and development" [Mahmoodi, 1991]

[81] See also "Committed to meeting performance standards, (such as output, service, individual)." [Mahmoodi, 1991]; [ISO 17799] (for security policies)

[82] See also Dewey, Barbara I. "Leadership and University Libraries: Building to Scale at the Interface of Cultures." *Journal of Library Administration* 42, no. 1 (2005): 41-50; Winston, Mark, ed. *Leadership in the Library and Information Professions: Theory and Practice*. Lanham, MD: Haworth Press, 2001. Also published as a theme issue on leadership. *Journal of Library Administration*. 32 (3/4) 2001; Winston, Mark. "Leadership Research in Library and Information Science," in Marie Radford and Pam Snelson, eds. Academic Libraries: Research Perspectives II. (forthcoming).

[83] Adapted from OAIS. See also Configuration Management - Configuration management provides for consistent identification of system components (software configuration items, hardware configuration items, and documentation) and controls changes to these components throughout the life cycle. [ERA Functional Area]; A4.4 Repository has ongoing commitment to risk, benefit, investment, and expenditure analysis and reporting (including assets, licenses, and liabilities). [Audit Checklist] Business continuity management in [ISO 17799]

[84] See also A5.4 If repository ingests digital content with unclear ownership/rights, it has policies addressing liability and challenges to those rights. [Audit Checklist]; "Confronts and manages conflict." [Mahmoodi, 1991]

[85] See also "Understands the roles and responsibilities of library board members and develops the board to make effective decisions in policy, planning, and financial issues." "Board relations and development"; "Prepare documents for board: reports, draft agreements, requests for action, policies, etc"; "Make recommendations for action"; "Implement decisions for board"; "Provide learning opportunties to develop boards as effective decision makers" [Mahmoodi, 1991]; Part 1, E.5. Management Support and Program Marketing [ICRM]

[86] See also Quality Management - Quality management establishes a framework for ERA's compliance with accepted industry and NARA standards and supports delivery of products and services that meet ERA requirements. [ERA Functional Area]; Audit Submission [OAIS]; A5.3 Repository tracks and manages copyrights and restrictions on use as required by contract or license [Audit Checklist].

[87] See also "Recognizes changes in the economic and political environment that mandate change in the library."; "Keeps up-to-date with conditions, developments, and future trends in the library and information field." [Mahmoodi, 1991]

[88] This function and numerous sub-functions adapted from "Plan" in [NDIIPP Life Cycle]. See also "A4.1 Repository has short- and long-term business planning processes in place to support sustainability"; "A4.2 Repository has in place at least annual processes to review and adjust business plans as necessary." [Audit Checklist]; "Uses appropriate planning techniques." "Long-range, short-range, and strategic planning"; "Maintain planning cycle"; "Monitor progress"; "Coordinate planning efforts of staff and board" and "Integrate program design with planning" [Mahmoodi, 1991]

[89] See also Project management [Abell, 2000]; Module 9-a: Project Management [UNC-VT]; Winston, Mark D., and Tara Hoffman. "Project Management in Libraries." *Journal of Library Administration* 42, no. 1 (2005): 51-61; Winston, Mark. *Project Management in Librarie*s. Libraries Unlimited. (Forthcoming).

[90] See also A3.1 Repository has a mechanism in place for reviewing, updating, and developing comprehensive policies and procedures as repositories grow and as the community practice evolves. [Audit Checklist]

[91] Adapted from [ERA Functional Area]. See also Change management [Abell, 2000]; "Recognizes the need for change in organizational structure," "Implements plans and organizational changes," and "Initiates, implements, and manages change." [Mahmoodi, 1991]

[92] [ERA Functional Area] For a breakdown and discussion of sub-functions, see Price, Laura, and Abby Smith. "Managing Cultural Assets from a Business Perspective." Washington, DC: Council on Library and Information Resources, and Library of Congress, 2000. http://www.clir.org/pubs/abstract/pub90abst.html

[93] See also 5-f: Security [UNC-VT].

[94] See also "Uses mathematical and statistical techniques to manipulate data." [Mahmoodi, 1991]

[95] Adapted from "Preservation Planning" in OAIS.

[96] OAIS.

[97] OAIS.

[98] OAIS.

[99] OAIS.

[100] See Hedstrom, Margaret and Christopher A. Lee. "Significant properties of digital objects: definitions, applications, implications." In *Proceedings of the DLM-Forum 2002, Barcelona, 6–8 May 2002*, 218-227. Luxembourg: Office for Official Publications of the European Communities, 2002. http://www.ils.unc.edu/callee/sigprops_dlm2002.pdf; Investigating the Significant Properties of Electronic Content Over Time (INSPECT). http://www.jisc.ac.uk/whatwedo/programmes/programme_rep_pres/inspect.aspx. The origin of the phrase "significant properties" is the CEDARS project: http://www.leeds.ac.uk/cedars/

[101] Adapted from A233 in [InterPARES].

[102] OAIS. See also User Behavior/Interactions (includes 6-a: Info needs, relevance; 6-b: Search strategy, info seeking behavior, user modeling; 6-c: Sharing, networking, interchange (e.g., social); 6-d: Interaction design, info summarization and visualization, usability assessment) ; 7-a: Search engines, IR, indexing methods; 7-d: Routing, community filtering 7-e: Web publishing (e.g., wiki, rss, Moodle, etc.) [UNC-VT]; Packaging and Delivery [NEDLIB]

[103] Adapted from OAIS. Sub-functions are derived from OAIS and MacNeil, Heather. *Without Consent: The Ethics of Disclosing Personal Information in Public Archives*. Chicago, IL: Society of American Archivists and Scarecrow Press, 1992.

[104] Adapted from OAIS.

[105] Adapted from Expose [Pathways Project]. See also Announce Availability [ICPSR]

[106] See also 4-a: Information architecture (e.g., hypertext, hypermedia) [UNC-VT]; "The repository maintains two data files, one containing the raw data and the other containing the data in a public use or disclosure-free format. Personal information is processed so that the specific individuals to whom it relates cannot be identified and thus the information can be released for general research use." [MacNeil, 1992, p.134].

[107] Adapted from OAIS. For a sub-function related to Anonymizing or de-identifying data, see MacNeil, 1992; Hedstrom, Margaret L. "Privacy, Computers, and Research Access to Confidential Information." *Midwestern Archivist* 6, no. 1 (1981): 5-18.

[108] See also 6-c: Sharing, networking, interchange (e.g., social); 6-d: Interaction design, info summarization and visualization, usability assessment [UNC-VT]; Packaging and Delivery [NEDLIB].

[109] See also Bisco, Ralph L. "Social Science Data Archives: A Review of Developments." *American Political Science Review* 60, no. 1 (1966): 93-109; 7-b: Reference services [UNC-VT].

[110] Adapted from Pugh, Mary Jo. *Providing Reference Services for Archives and Manuscripts*, 111-47. Chicago, IL: Society of American Archivists, 2005

[111] Sub-functions are adapted from Pugh, 2005.

[112] Sub-functions are adapted from Pugh, 2005. See also 7-c: Recommender systems [UNC-VT].

[113] OAIS. See also 5. Architecture (agents, mediators) [UNC-VT].

[114] OAIS.

[115] OAIS.

[116] OAIS. See also 5-f: Security [UNC-VT].

[117] See also "Withdraw/Reject" in Anderson, Sheila, Mike Pringle, Mick Eadie, Tony Austin, Andrew Wilson, and Malcolm Polfreman. "Digital Images Archiving Study." Arts and Humanities Data Service, 2006; ISO/TR 12037:1998. Electronic imaging -- Recommendations for the expungement of information recorded on write-once optical media

[118] Adapted from [ISO 15489]

[119] Collaboration from [Stein 2004, figure 3]. See also Brennan, Patricia, Karen Hersey, and Georgia Harper. "Strategic and Practical Considerations for Signing Electronic Information Delivery Agreements." Washington, DC: Association of Research Libraries, 2002. http://www.arl.org/sc/licensing/licbooklet.shtml; Principles For Licensing Electronic Resources. American Association of Law Libraries (2004). http://www.aallnet.org/committee/reports/LicensingPrinciplesElecResources.pdf; Producer-Archive Interface Methodology Abstract Standard. Consultative Committee for Space Data Systems. December 2003. http://www.ccsds.org/CCSDS/documents/651x0b1.pdf; Shared Electronic Resource Understanding (SERU). http://www.niso.org/committees/SERU/; "Establishes cooperative working relationships with local government departments." [Mahmoodi, 1991] Several sub-functions are derived from the OAIS, Section 6.1.

[120] (Under Management) [OAIS]. See also "Confronts and manages conflict." [Mahmoodi, 1991].

[121] Adapted from: "A1.2 Repository has a formal succession plan, contingency plans, and/or escrow arrangements in place in case the repository ceases to operate or substantially changes its scope." [Audit Checklist]

[122] Sub-functions derived from [Audit Checklist], [OAIS], and [Mahmoodi, 1991].

[123] See also "Negotiates and maintains effective relations with unions." [Mahmoodi, 1991]

[124] Abraham, Thomas, Cynthia Beath, Christine Bullen, Kevin Gallagher, Tim Goles, Kate Kaiser, and Judith Simon. "IT Workforce Trends: Implications for IS Programs." *Communications of the Association for Information Systems* 17 (2006): 1147-70. See also Acquisition support - includes all activities associated with obtaining a contractor to build the ERA System, including producing the Request for Proposal (RFP) and planning for and supporting source selection activities. After contract award, the contractor will be monitored for contract compliance. [ERA Functional Area]; "RLG Guidelines for Creating a Request for Proposal for Digital Imaging Services." Ithaca, NY: Cornell University Library, 1998. http://www.oclc.org/programs/ourwork/past/digimgtools/RFPGuidelines.pdf

[125] See also "Lobbies effectively for libraries with national, state, and local officials."; "Prepares the library board for its role in representing the library and lobbying." [Mahmoodi, 1991]; Persuasion [Abell, 2000]

[126] Adapted from [Abell, 2000]. See also "Negotiates the best possible resources for the library in any given situation."; "Uses negotiating techniques appropriate to the situation (e.g., one-on-one, vendor, union)." And "Relates library needs and goals to those of funding officials and agencies." [Mahoodi, 1991]

[127] Numerous sub-functions are based on [DIRKS] and Finch, Elsie T. Freeman, ed. *Advocating Archives: An Introduction to Public Relations for Archivists*. Metuchen, NJ: SAA and Scarecrow Press, 1994.

[128] Adapted from: "Understands and promotes the library's role within the larger governmental organization." [Mahmoodi, 1991]

[129] See also "Is committed to public service including a commitment for the library to share, cooperate, and collaborate with other educational, cultural, and social agencies serving the community."; "Community involvement and representing library (marketing)"; "Increase visibility of library"; "Participate in meetings and activities of organizations within the community"; "Represent library with other governmental units and boards"; "Participate in professional organizations and the local professional community"; "Maintain relations with Friends of the Library and other volunteer groups" [Mahmoodi, 1991]

[130] Adapted from "DIRKS [Designing and Implementing Record Keeping Systems]: A Strategic Approach to Managing Business Information." National Archives of Australia, 2001. [DIRKS]

[131] [DIRKS] Several sub-functions derived from [InterPARES]. See also Assess Recordkeeping System, Part A9 of [Ingest Guide]

[132] Adapted from "Identification of recordkeeping requirements" [DIRKS]

[133] See also Characterization of SIP [OAIS] (Part of Ingest); Characterization (including Identification, Validation and Property Extraction) in Brown, 2006 (113-115).

[134] Includes: content analysis (see, Holsti, Ole R. *Content Analysis for the Social Sciences and Humanities*. Reading, MA: Addison-Wesley, 1969; Krippendorff, Klaus. *Content Analysis: An Introduction to Its Methodology*. 2nd ed. Thousand Oaks, CA: Sage, 2004); and identification and characterization if file formats (see Abrams, 2005).

[135] Adapted from B1.6 of [Audit Checklist]. See also "The Quality Assurance function validates (QA results) the successful transfer of the SIP to the staging area. For digital submissions, these mechanisms might include Cyclic Redundancy Checks (CRCs) or checksums associated with each data file, or the use of system log files to record and identify any file transfer or media read/write errors." [OAIS]; Conduct Quality Assurance [NDIIPP Life Cycle] (Part of Produce); Verify technical integrity [NDIIPP Life Cycle] (Part of Produce); Assess and assert quality [NDIIPP Life Cycle] (Part of Produce); "Quality assurance and cataloging" in Brown, 2006 (69-81). See JHOVE documentation for further breakdown of sub-functions.

[136] See also "Validate checksums "[Portico]

[137] [Portico].

[138] [Portico].

[139] [Portico].

[140] See also Validate Asset Inventory [Portico].

[141] See also 2-c (8-c): File formats, transformation, migration [UNC-VT]. See also in [Audit Checklist]: A3. Procedural accountability & policy framework - "A repository must provide clear and explicit documentation of its requirements, decisions, development, and actions to ensure long-term access to digital content in its care."; A3.4 Repository has a documented history of the changes to its operations, procedures, software, and hardware, traceable to its preservation strategies where appropriate; A3.6 Repository commits to define, collect, track, and provide, on demand, its information integrity measurements; Brodie, Michael L., and Michael Stonebraker. *Migrating Legacy Systems: Gateways, Interfaces & the Incremental Approach*. San Francisco, CA: Morgan Kaufmann Publishers, 1995.

[142] See also "Acquisitions" and "Fiscal Management" in Evans and Saponaro, 2005; Chapman, Liz. Managing Acquisitions in Library and Information Services. Rev. ed. London: Facet, 2004.

[143] See also A5.2 Repository's contracts or deposit agreements specify and/or transfer appropriate preservation rights, as necessary. [Audit Checklist]

[144] For an example of this function, see Whitman, Cole. "Mapping Processes in Motion: Visualizing the ICPSR Data Pipeline." Paper presented at New Skills for a Digital Era, Washington, DC, May 31 - June 2, 2006.

[145] Steenbakkers, Johan F. "Treasuring the Digital Records of Science: Archiving E-Journals at the Koninklijke Bibliotheek." *RLG DigiNews* 8, no. 2 (2004). See also Module 9-c: DL Evaluation [UNC/VT Digital Library Curriculum]; 10.2. Conduct regular review process to evaluate OAIS performance and progress toward long-term goals. (Under Management) [OAIS]; A3.3 Repository is committed to formal, periodic review and assessment to ensure continued development. [Audit Checklist]; "Ensure evaluation of services and programs" [Mahmoodi, 1991]

[146] See also A3.7 Repository commits to a regular schedule of certification and to notifying certifying bodies of operational changes that will change or nullify its certification status. [Audit Checklist]

[147] See also 9. Management and Evaluation (including 9-c: DL evaluation, user studies; 9-d: Bibliometrics, Webometrics) [UNC-VT]; "Understands and is able to use social science research methods to support the decision making process." [Mahmoodi, 1991].

[148] See also Abell, 2000.

[149] See also "Ensure that library materials and services provided meet needs of communities" in Mahmoodi, Suzanne H., and Geraldine King. "Identifying Competencies and Responsibilities of Top Management Teams in Public Libraries." *Minnesota Libraries* 30, no. 1-2 (1991-92): 27-32.; "Define the informational needs of users by such techniques as customer surveys, analysis of user requests, and keeping abreast of current research trends and strategies." In Handbook for Certified Archivists. Albany, NY: Academy of Certified Archivists. 2006.

[150] "6-d: Interaction design, info summarization and visualization, usability assessment" in [UNC-VT]

[151] For an early discussion of the importance of these functions within a data archive, see: Bisco, 1966.