UNT Digital Libraries: Risk Analysis and Management Strategy Plan

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Risk Analysis and Management Strategies: UNT Libraries' Digital Collections

Introduction

This document describes threats that could disrupt normal operations of the UNT Libraries' Digital Collections and prevent the repository from fulfilling its mission to support "..the long-term collection, production, maintenance, delivery, and preservation of a wide range of high-quality digital resources and services for the UNT Community and users throughout the world." for short or long periods of time. This document also details risk-minimization strategies, system infrastructures, operating practices, and business relationships that the UNT Libraries employ to reduce the potential impact of these threats.

This document was prepared by the UNT Libraries' Digital Libraries Division in order to identify risks and document the management strategies of those risks to the UNT Libraries' Digital Collections. While the Digital Libraries Division is responsible for the technology, workflows, and infrastructure of the Digital Collections, success of this work relies on close coordination between curators and stakeholders from other departments and divisions throughout the UNT Libraries. The strategy discussed in this document heavily references and relies upon services provided and managed by the UNT Libraries' Facilities and Systems Division and its two units, Technology and Computer Operations (Lib-TACO) and Facilities. This document will refer to the UNT Libraries' Digital Collections or "repository," and the Digital Libraries Division as the primary stakeholders or "staff." This document also refers to the designated community of the Digital Collections comprising a broad audience:

- The UNT Extended Community (UNT students, faculty, staff, alumni, and administrators)
- Contributing partners and their constituents
- The larger academic community and researchers
- The general public throughout the world

The UNT Libraries have adapted a typology of threats developed by the Scholars Portal as part of their TRAC Audit Documentation that focuses on probable and manageable events in relation to the repository's physical environment, technology infrastructure, repository content, personnel requirements, business relationships, and legal obligations. In the original development of this typology, Scholars Portal examined risk management strategies practiced by a number of authorities in the digital curation community, exemplars include CCSDS typology, PLATTER typology, HathiTrust disaster planning typology. These typologies are included in the document below for reference.

In order to identify and document possible threats to the Digital Collections, the UNT Libraries team borrowed heavily (with permission) from the original document created by the Scholars' Portal.

Typologies of threats

This section introduces a number of risk analysis frameworks used by the digital curation community. The structure employed by Scholars Portal for their own Risk Analysis and Management Strategies documentation was reviewed in creating the current documentation. The UNT Libraries, having adopted the Scholars Portal framework, is including portions of that original analysis as a point of reference to prior work conducted in this area. This section outlines some typologies of threats found in the Consultative Committee on Space Data Systems' (CCSDS) Audit and Certification of Trustworthy Digital Repositories criteria, the PLATTER framework developed by DigitalPreservationEurope (DPE), and the disaster recovery planning process used by HathiTrust.

CCSDS typology

The *Audit and Certification of Trustworthy Digital Repositories* criteria expects that the repository "maintain[s] a systematic analysis of security risk factors associated with data, systems, personnel, and physical plant" (sec. 5.2.1). In their detailed explanation, the checklist recommends that the repository identify and manage risks related to:

- Hardware, software, communications equipment, facilities, and firewalls
- Physical environment
- Personnel, management, and administration
- Operations and service delivery
- Income, budget, reputation, and mandate
- Contractual and regulatory compliance
- Personnel knowledge and skills
- External threats and denial of service attacks
- Relationships with third parties

PLATTER typology

The PLATTER (Planning Tool for Trusted Electronic Repositories) checklist developed by DigitalPreservationEurope (DPE) encourages repositories to focus on "foreseeable disasters" in eight general categories (p. 37-39):

- Economic upheaval

- Political upheaval
- Loss of purpose/mandate
- Technological upheaval
- Environmental upheaval
- Loss of users and/or the arrival of competition
- Loss of educated key staff
- Breach of security

HathiTrust disaster planning typology

As a part of their disaster recovery planning process, HathiTrust identified ten types of threats:

- Hardware failure or obsolescence and data loss
- Network configuration errors
- Network security and external attacks
- Format obsolescence
- Core utility and/or building failure
- Software failure or obsolescence
- Operator error
- Physical security breach
- Natural or manmade disaster
- Media failure or obsolescence

Scholars Portal typology

The typologies listed in this section represent different perspectives on disaster, ranging from abstract, unpredictable threats ("political upheaval") to tangible, expected threats ("software obsolescence"). From these, several common themes emerge, and threats are grouped into five general categories.

Economic, political, social, or legal threats. Includes:

- Loss of funding or institutional host
- Loss of staff
- Contractual liability
- Regulatory liability

Technology-related failures. Includes:

- Hardware failure and obsolescence
- Storage media failure (includes bit rot)
- Software failure and obsolescence
- File format-related obsolescence

- Loss of critical hardware or software support

Manmade threats. Includes:
- Operator error
- Sabotage by insider
- Cyber attack
- Physical security incident

Natural threats. Includes:
- Fire
- Flood
- Severe weather (blizzard, tornado, thunderstorm)
- Earthquake

Utility or environmental/building systems failure. Includes:
- Power failure
- Plumbing failure
- Server room cooling failure
- Heating, air conditioning, or air quality failure

Threat Documentation Model

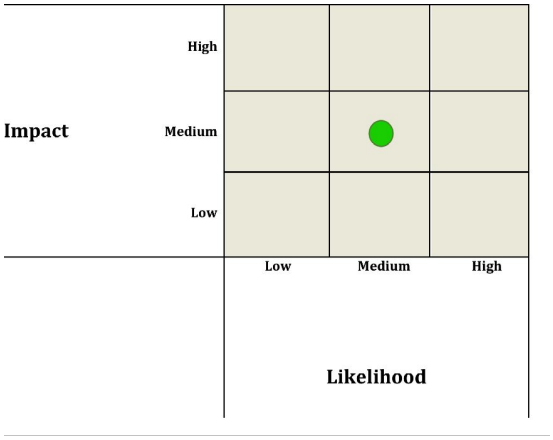
The threats presented in this document have the following categories of information present for each documented threat.

Dependencies

Why this threat is important to the operation of the UNT Libraries' Digital Collections and associated services.

Likelihood and impact assessment

To assess the risks associated with individual threats and prioritize management strategies, in their original model, Scholars Portal estimated the likelihood and impact of each threat and plotted the combined result on a graph. The UNT Libraries have adopted this model to assess risks. Assessing threats in terms of likelihood and impact is a common strategy in disaster planning and is recommended by the Federal Emergency Management Agency (FEMA) and the National Institute of Standards and Technology (NIST). Here is an example of a graph:



Likelihood and impact are represented on the graph as a green marker. The position of each dot is speculative and serves as a guide for clarifying risks and planning management strategies.

Likelihood is an estimate of the frequency of a type of event, divided into three periods for the purposes of this document:

High	occurs every 0-2 years
Medium	occurs every 3-7 years
Low	occurs every 8+ years

These are rough estimates, and exceptional events are always possible.

Impact is an estimate of the effect that a threat may have on the repository's content, services, and/or administration. The Digital Libraries Division divides impact into three categories of severity:

High	Large-scale data loss in the storage system and/or Prolonged service outage
Medium	Small-scale, isolated data loss in the storage system and/or

	Brief service outage
Low	No data loss in the storage system and Degraded system performance and/or Disruption of repository administration, maintenance, or workflow

In general, high-impact events may lead to widespread data loss and/or prevent the designated community from successfully accessing information or using one or more of the repository's services for a prolonged duration. Medium-impact events may lead to some data loss and/or brief service outages. Some medium-impact events, whether small-scale data loss or brief service outages (or both), may be corrected before affecting the designated community. Low-impact events do not lead to data loss, but may degrade system performance or disrupt administration of the repository in one way or another. For example, loss of staff does not lead to data loss, but can easily disrupt ongoing maintenance and/or interrupt projects. Please note that data loss and service outages have many causes, and this document cannot describe all of them.

Management strategy

Strategies that the Digital Libraries Division employ to mitigate the impact(s) of this risk.

Identified Threats

Economic, political, social, or legal threats

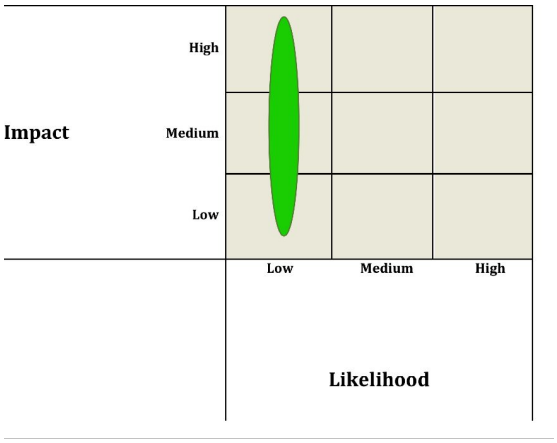
Loss of funding

Dependencies

The UNT Libraries' Digital Collections operate using funding designated by the UNT Libraries in the form of wages for librarians, staff, and student assistants; technology infrastructure support; funding for digitization; and travel and training. The UNT Libraries are an academic unit within the University of North Texas, the flagship campus in the UNT System, which is a public, state university. In addition to annual funding from the UNT Libraries, the Digital Libraries Division

receives external funding in the form of digitization fees from partner institutions who contribute content to The Portal to Texas History. For that reason, the UNT Libraries' Digital Collections are vulnerable to reductions in funding for higher education by the university, state, and federal governments. UNT Libraries' Digital Collections are also vulnerable to governmental and university funding freezes. Cost increases that are not matched by funding increases are effectively reductions in funding.

Likelihood and impact assessment



Loss of funding could span a range of probabilities and impacts. Full loss of funding (illustrated) is a low-likelihood, low- to high-impact event. Full loss of funding could force the UNT Libraries' Digital Collections into one of two scenarios: either to suspend operations until the repository can establish a new source of funding, or to force it to engage in a succession plan for the repository. A swift transition to a new source of funding minimizes the chance of a service outage. Partial loss of funding or freezes (not illustrated) are moderate-likelihood, low-impact events. Partial loss could slow or halt efforts to maintain existing collections, infrastructure, and services and could delay the development of new collections and new services. The Digital Collections expect that funding will fluctuate in relation to the financial health of the State of Texas and the university. In addition, funding could shrink if prospective partner libraries choose to work with a competitor rather than with the UNT Libraries for content services.

Management strategy

The Digital Libraries Division strives to provide a cost-effective model for the digitization, archiving, and access to resources held in the UNT Libraries' Digital Collections.

The UNT Libraries have a commitment of funding for regular hardware replacement and/or upgrade. The UNT Libraries have established an Archival Storage Replacement Fund to help

reduce the impact of replacing server and storage hardware for the UNT Libraries' Digital Collections infrastructure during planned for replacement cycles.

The UNT Libraries replace hardware and storage on a five-year cycle (i.e., every five years, or less); however, media exhibiting performance problems or on a more frequent schedule may be replaced before the end of five years. Whenever possible, the UNT Libraries also purchase five-year warranties for hardware components.

In fall 2012, the UNT Libraries established The Portal to Texas History Endowment. The endowment will enable UNT to extend the impact of the Portal by creating a permanent, sustainable source of income. Funds derived from this endowment will serve as a catalyst for enhancing future technology development, acquisition, and support; for adding collections and content to the Portal; and for creating lesson plans and supporting new educational initiatives.

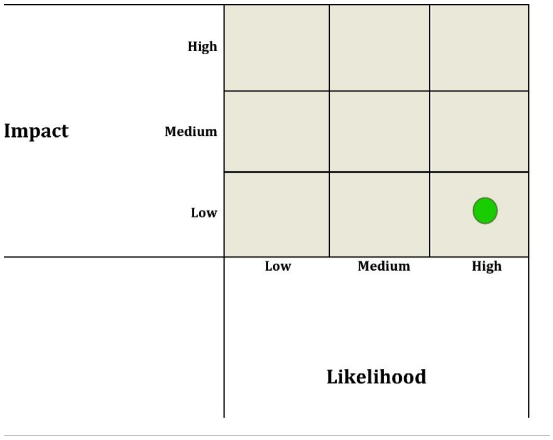
The UNT Libraries work with the Office of the Provost and Vice President for Academic Affairs to establish and secure funding required to support the operations of the UNT Libraries and subsequently the UNT Libraries'' Digital Collections and associated infrastructure and staffing.

Loss of staff

Dependencies

The UNT Libraries' Digital Collections rely on knowledgeable and skilled personnel to maintain the repository and satisfy the evolving needs and expectations of the designated community. The Digital Collections also depend on experienced leaders who can manage projects, mentor personnel, and advocate on behalf of the repository. The Digital Libraries Division and the Digital Collections require stable, typical, and ideally low rates of staff turnover in order to manage projects effectively and efficiently.

Likelihood and impact assessment



Loss of staff is a high-likelihood, low-impact event. Loss of knowledgeable and skilled personnel is inevitable in the life of an organization, and therefore it is a high-likelihood event, but losses do not typically lead to service outages or data loss. The severity of the impact will depend on the individuals lost. Loss of staff at any level could affect the ability of the Digital Libraries Division to operate in an efficient and innovative manner. Loss of leadership could disrupt business relationships, disrupt administrative activities, and affect the reputation of the repository. The loss of a large number of staff could slow or stop efforts to maintain existing content, infrastructure, and services and delay the development of new content and new services.

Temporary loss of staff due to widespread illness (not illustrated) is a low-likelihood, low-impact event. Temporary loss of staff could slow or stop administrative activities, project development, and ongoing maintenance.

Management strategy

The Digital Libraries Division delegates responsibility for projects and repository administration to several people in order to reduce single points of failure.

The Digital Libraries Division uses a number of technologies including shared network drives for documentation, and an internal Wiki as a collaborative documentation portal, for knowledge management, project planning, and document sharing.

The Digital Libraries Division includes documentation of major changes to its organizational and technical infrastructure in its annual Operational Plans and other reports that are submitted to the UNT Libraries' Administrative Offices.

The Digital Libraries Division maintains an organizational chart that identifies appropriate staff who can explain repository practices and workflows.

The Digital Libraries Division reduces the rate of staff turnover by offering its employees competitive compensation and benefits, clear and reasonable performance expectations, constructive and practical feedback, and opportunities for advancement and professional development.

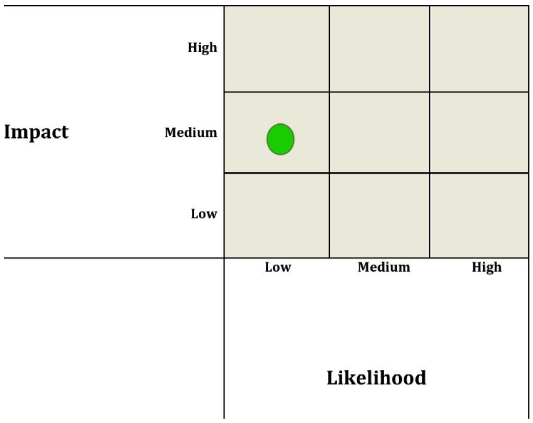
The Digital Libraries Division shares copies of its yearly Operational Plan via the UNT Libraries' UNTranet portal.

Contractual liability

Dependencies

Contractual agreements between partieis involved with the UNT Libraries' Digital Collection exist between the University of North Texas, content partners, and in some situations external vendor services such as software companies and service providers. It is critical that the Digital Collections (and the greater University of North Texas) fulfill these contracted obligations.

Likelihood and impact assessment



Contractual liability is a low-likelihood event. It is difficult to estimate the impact of contractual liability because the context and circumstances of any problem may vary widely. In some cases, contractual liability may lead to a temporary service outage while staff from the Digital Libraries Division work to resolve the problem. In other cases, the impact may be strictly administrative or financial (not illustrated). Removal of content by a Provider would be a high-impact event (not illustrated).

Management strategy

All legal documents, contracts, and memoranda of understanding are vetted and signed by the UNT Office of General Counsel (OGC) or body designated with signing authority by the OGC.

The Digital Libraries Division staff work closely with the rest of the UNT Libraries to ensure that the operations are consistent with relevant state and federal laws.

When necessary, the Digital Libraries Division seeks contextual advice from the UNT Libraries' Director of Copyright and legal advice from the UNT Office of General Council.

Licensing agreements between UNT and content partners are governed by and construed in accordance with the laws of the State of Texas.

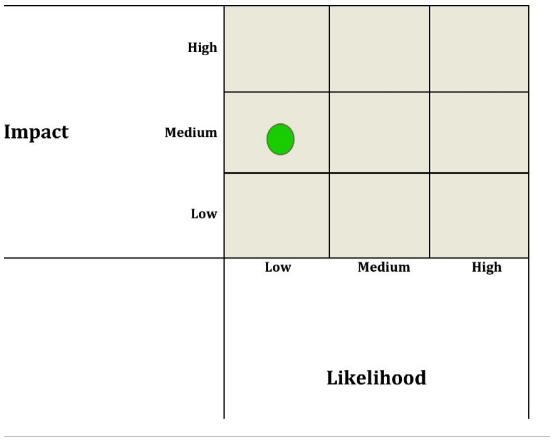
In all matters of ingest, data management, archival storage, dissemination, and repository administration, the Digital Libraries Division operates according to the terms of license agreements between UNT and content partners. These agreements describe usage rights in detail and provide UNT with clear directions for managing ingest processes, recording administrative metadata, and implementing security and access controls.

Regulatory liability

Dependencies

The Digital Libraries Division must design, implement, and administer the UNT Libraries' Digital Collections in a manner that is consistent with relevant state and federal laws.

Likelihood and impact assessment



Regulatory liability is a low-likelihood event. It is difficult to estimate the impact of regulatory liability because the context and circumstances of any problem may vary widely. In some cases, regulatory liability may lead to a temporary service outage while staff from the Digital Libraries Division work to resolve the problem. In other cases, the impact may be strictly administrative or financial (not illustrated).

Management strategy

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When necessary, the Digital Libraries Division seeks contextual advice from the UNT Libraries' Director of Copyright and legal advice from the UNT Office of General Council.

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Technology-related threats

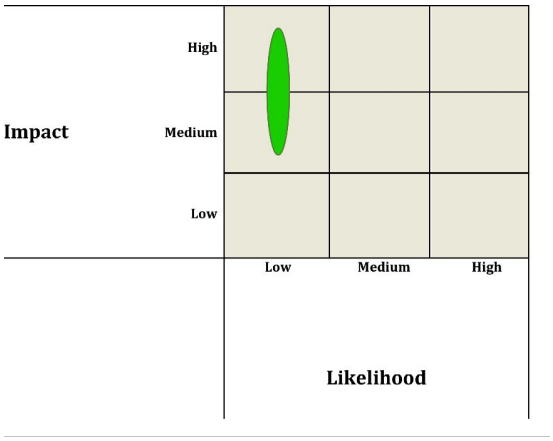
Hardware failure

Dependencies

The mission and related activities of the UNT Libraries' Digital Collections rely on the continuous, error-free operation of servers, a storage array, and workstations. The UNT Libraries uses Dell servers and Dell RAID storage array housed redundantly in the UNT Libraries and in the UNT ITSS secure computing facility at the Discovery Park research campus. Hardware may fail due to spontaneous malfunctions, manufacturing defects, or improper operation. Points of failure include power supplies, fans, connectors, and (highly unlikely) chips and motherboard components.

Storage media failure due to mechanical failure, physical degradation, or magnetic failure is analyzed as a stand-alone topic in the section titled "Storage media failure that leads to data loss."

Likelihood and impact assessment



Hardware failure is a low-likelihood event. However, hardware failure can span a range of impacts depending on the components involved and the nature of the failure. The number of components and/or sites involved may affect the duration of any outage.

There is a risk that large-scale hardware migrations could cause temporary service outages and lead to data loss.

Management strategy

Digital Libraries Division staff work closely with personnel from the UNT Libraries' Technology and Computer Operations (Lib-TACO) group to monitor hardware health, perform routine maintenance, and install replacements or upgrades. Lib-TACO also has a stock of surplus component for some hardware.

The Digital Libraries Division uses a variety of widely-accepted, industry-standard techniques and tools to monitor the repository's hardware platform. Systems administrators in the Digital Libraries Division and Lib-TACO receive information about system behavior and usage from a number of custom-built scripts, a Nagios monitoring program, and monitoring functionality built into the hardware. These tools warn administrators about abnormal activity such as excessive processor loads and slow response times. In addition, staff monitor critical processes, such as ingest and data management, for malfunctions and suboptimal performance.

Feedback from the designated community is an important source of information about system behavior and hardware performance. Feedback from the designated community provides valuable information about response times, page loading, and overall system performance.

The UNT Libraries have a commitment of funding for regular hardware replacement and/or upgrade. The UNT Libraries have established an Archival Storage Replacement Fund to help reduce the impact of replacing server and storage hardware for the UNT Libraries Digital Collections infrastructure during planned for replacement cycles.

The UNT Libraries replaces hardware on a five-year cycle (i.e., at least every five years) even if the hardware is functioning normally.

The UNT Libraries purchases a five-year warranty for servers and hardware components when possible.

When server or hardware changes are indicated, Digital Libraries Division staff collaborate with personnel from Lib-TACO to evaluate hardware alternatives and the timing of technology changes on a cost-benefit basis. Evaluations vary in formality according to the circumstances. The most extensive assessments take place whenever large components, such as the repository's servers or storage array network, require replacement. When necessary, systems

administrators consult vendors for additional information and advice, taking into account the cost of hardware and future maintenance.

Large-scale hardware migration is carried out by systems administrators and programmers from the Digital Libraries Division and Lib-TACO. Staff test and evaluate new hardware in isolation before moving the repository to the new component(s). In addition to tests and checks carried out by automated monitoring programs, staff manually assess changes by examining samples of relevant content. Staff evaluate changes for their effect on the integrity and understandability of information, the speed and interoperability of the system, and the accessibility and usability of disseminated content. Whenever hardware changes involve migrating data, the repository performs checksum and file size tests to validate the integrity of information.

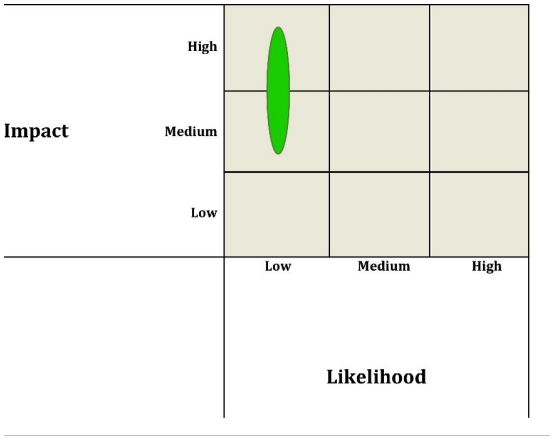
The Digital Libraries Division and Lib-TACO carry out regular backup of data, databases, and applications according to local standard backup practices. These backups are intended to serve as the basis for restoration of server infrastructure materials in the event of data corruption or loss. Data stored as part of the UNT Libraries' Coda repository is migrated between two storage facilities, one in the Willis Library, and one in the UNT System Data Center at the UNT Discovery Park research campus.

Storage media failure that leads to data loss

Dependencies

Storage media failure refers to mechanical failure, physical degradation, or magnetic failure in disk drives that may lead to data corruption or loss. The failure of multiple drives in the RAID array may lead to data loss and cause a service outage until Lib-TACO and the Digital Libraries Division can restore the affected content from backup or other replicated copy of the data. Media failure can be considered a subset of hardware failure, but it is analyzed here as a stand-alone topic because of the critical impact of media refreshment on the long-term preservation of digital information.

Likelihood and impact assessment



Storage media failure that leads to data loss is a low-likelihood, medium- to high-impact. The impact of storage media failure varies according to the extent of the damage, the data affected, and the duration of any service outage.

Storage media may fail in a RAID array without causing data loss. For example, the failure of a single drive in the RAID array should not lead to data loss. However, a drive failure will compromise the array's overall redundancy.

There is a risk that disk replacement and data copying operations could cause temporary service outages.

Management strategy

The repository uses replicated Dell MD3260i and MD3060e storage arrays for redundancy of digital master files.

The repository uses replicated Dell MD3200i and MD1200 storage arrays for redundancy of access files.

Both sets of Dell storage arrays employ RAID technology for purposes of data redundancy.

The Dell arrays have health-monitoring, diagnostic, and error-correction tools. The storage controllers will automatically report errors to Lib-TACO staff.

The Digital Libraries Division uses a number of tools and procedures to detect bit corruption or loss. The repository uses widely-accepted hashing techniques to generate digest values for new content and carries out regular, automated fixity checks on archived content. For each digital object, the repository generates and records MD5 values for each file associated with the object. Digest values are stored in the preservation metadata, which is separate from the objects files.

The UNT Libraries replaces storage media according to a predetermined schedule or whenever media exhibit performance problems. As a rule, the UNT Libraries refreshes its storage array media within a 5-year period (i.e. every 5 years or less) even if the drives are functioning normally and appear healthy.

The UNT Libraries purchases a 5-year warranty for hardware components when possible.

The UNT Libraries have a commitment of funding for regular hardware replacement and/or upgrade. The UNT Libraries have put in place an Archival Storage Replacement Fund to help reduce the impact of replacing server and storage hardware for the UNT Libraries Digital Collections infrastructure during planned for replacement cycles.

The procedures and tests involved in storage media change are very similar to those involved in hardware change. Please see the section title “Hardware failure,” above, for details.

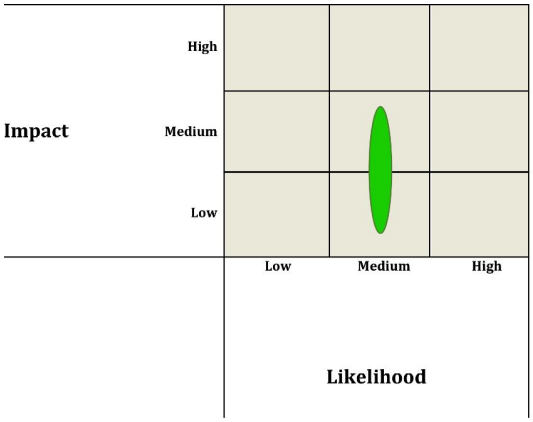
The Digital Libraries Division and Lib-TACO carry out regular backup of data, databases, and applications according to standard backup practices. These backups are intended to serve as the basis for restoration of server infrastructure materials in the event of data corruption or loss. Data stored as part of the UNT Libraries’ Coda repository is migrated between two storage facilities, one in the Willis Library, and one in the UNT System Data Center at the UNT Discovery Park research campus.

Hardware obsolescence

Dependencies

The UNT Libraries’ Digital Collections rely on hardware components that work well with the repository’s applications, databases, and data and that also interoperate well with associated components inside and outside the system.

Likelihood and impact assessment



It is very difficult to assess the likelihood and impact of hardware obsolescence because it depends on the repository growth rate as well as developments in hardware, software, and user behavior. It may affect diverse users in different ways. Degraded performance is the first sign of hardware obsolescence, but service outages should be expected. The impact could vary from low to medium (and possibly high, not illustrated) in relation to the components involved, the services affected, and the duration of any service outage. Hardware obsolescence is medium-likelihood in the context of repository growth and wider technological change.

There is a risk that large-scale hardware migrations could cause temporary service outages and lead to data corruption or loss.

Management strategy

The UNT Libraries strategy for minimizing the risk of hardware obsolescence is largely the same as its strategy for hardware failure. Please see above, for details.

Software failure

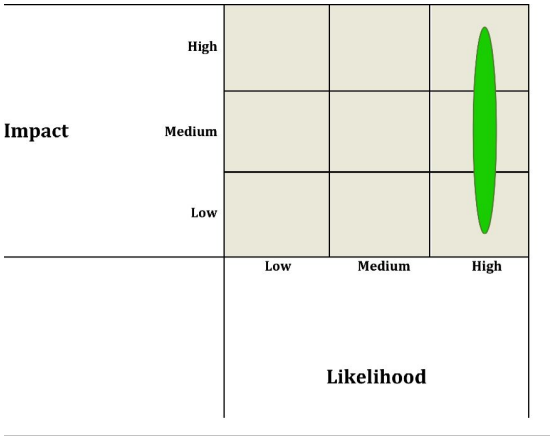
Dependencies

The UNT Libraries' Digital Collections and the Digital Libraries Division depend on a variety of software components to carry out operations and fulfill their mission. The repository uses a combination of open-source and custom-built software to ingest and transform content, manage backup, disseminate content, and deliver various services.

It is necessary for the repository to install new software or modify existing software as a part of normal operations. Software failure is typically confined to bugs or incompatibilities that appear during or after software changes. The CCSDS' Audit and Certification of Trustworthy Digital Repositories checklist singles out security patches and firmware updates for special concern and states that they "are frequently responsible for upsetting alternative aspects of system functionality or performance" (sec. 5.1.1.4). Software failure could force the Digital Libraries

Division to suspend operations of the Digital Collections until the affected systems can be thoroughly analyzed, repaired, and tested.

Likelihood and impact assessment



Software failure is a high-likelihood, low- to high-impact event. It is a high-likelihood event because bugs, glitches, and incompatibilities are difficult to predict and eliminate. The Digital Libraries Division uses widely-accepted, industry-standard procedures for testing and evaluating software changes, but small errors or conflicts sometimes escape testing. The impact may vary from low to high in relation to the systems affected, the duration of any service outage, and the extent of any data loss.

There is a risk that large-scale software migrations could cause temporary service outages and lead to data corruption or loss.

Management strategy

Software development, testing, and improvement is an ongoing process of the Digital Libraries Division. In general, there is no time when software is not subject to monitoring and evaluation.

The Digital Libraries Division uses a variety of current, widely-accepted, industry-standard techniques and tools to monitor the repository's applications. Systems administrators and programmers receive information about system behavior and usage from a number of custom-built scripts.

Feedback from the designated community provides valuable information about accessibility, usability, understandability, and holdings. The Digital Libraries Division receives ongoing feedback about application behavior and interface design from its designated community.

Lib-TACO staff evaluate all mandatory and optional security patches and software/firmware updates on a risk-benefit basis. Staff apply all mandatory security patches and software/firmware updates. Staff may or may not apply optional patches or updates.

The UNT Libraries have a commitment of funding for regular software replacement and upgrade. The UNT Libraries have no fixed schedule for software replacement, but relies on internal performance reports and software support availability to indicate when software change is needed.

When software changes are indicated, staff in the Digital Libraries Division collaborate with personnel from Lib-TACO to evaluate software alternatives and the timing of software changes on a cost-benefit basis.

The Digital Libraries Division in collaboration with Lib-TACO tests and evaluates changes to software in isolated development environments to minimize the risk that changes will disrupt normal operations or cause data corruption or loss. Developers cannot write changes directly to the production server. In addition to automated tests and checks performed by programs, Digital Libraries Division staff manually evaluate changes by examining samples of the relevant content. Staff evaluate changes for their effect on the integrity and understandability of information, the speed and efficiency of the system, and the accessibility and usability of disseminated information.

The Digital Libraries Division retains historical versions of software so that changes to critical processes can always be reversed. The repository's backup process makes regular copies of the code versioning system.

To support long-term infrastructure planning, Lib-TACO has an inventory of hardware and software.

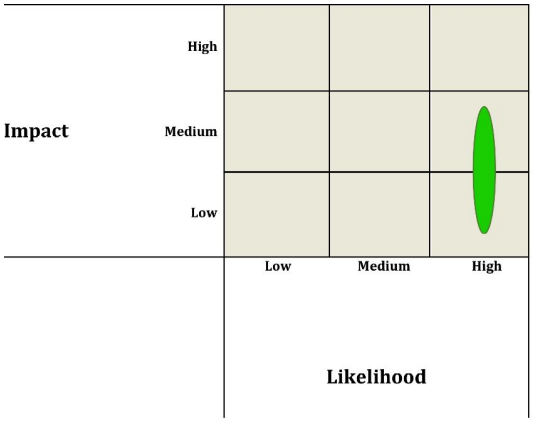
Software obsolescence

Dependencies

The UNT Libraries' Digital Collections depend on software that interoperates well with hardware, data, and applications inside and outside the repository. In addition, dissemination software and web services must meet the evolving needs and emerging expectations of the repository's designated community. The Digital Libraries Division uses a combination of commercial, open-source, and custom-built software to ingest and transform content, manage backup, disseminate content, and deliver various services.

File format obsolescence is a closely-related problem. In this document, it is analyzed as a stand-alone topic below.

Likelihood and impact assessment



It is very difficult to assess the likelihood and impact of software obsolescence because it depends on the repository growth rate as well as developments in hardware, software, and user behavior. It may affect diverse users in different ways. Degraded performance is the first sign of software obsolescence, but service outages should be expected. The impact could vary from low to medium (and possibly high, not illustrated) in relation to the services affected and the duration of any service outage. Software obsolescence is high-likelihood in the context of repository growth and wider technological change.

There is a risk that large-scale software migration could cause temporary service outages and lead to data corruption or loss.

While the Digital Libraries Division makes every effort to ensure that it offers web services that meet the needs and expectations of its designated community, the repository cannot guarantee that users have up-to-date and compatible software environments on their computers. For this reason, there is a risk that some users could experience software-related problems that the repository cannot control.

Management strategy

The Digital Libraries Division's strategy for minimizing the risk of software obsolescence is largely the same as its strategy for software failure. Please see above, for details.

To help users anticipate and manage certain software-related issues, the Digital Libraries Division added the following warning to The Portal to Texas History, the UNT Digital Library and The Gateway to Oklahoma History websites: "We recommend viewing this system with Firefox

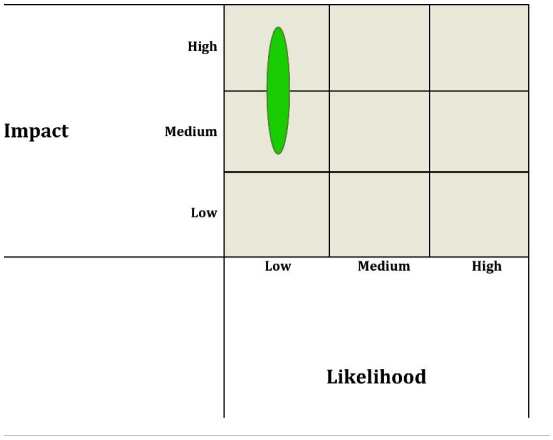
3, Google Chrome 3, Internet Explorer 7, Opera 10, Safari 3, or their newer versions." A link to the repository's help services and feedback forum is available on the user interface.

File format-related obsolescence

Dependencies

The UNT Libraries' Digital Collections ingest, preserve, and disseminate a variety of file formats. While the repository is not dependent on or restricted to any particular format or group of formats, it aims to use well-known, widely-accepted formats that support long-term preservation. Please see the "UNT Libraries Digital Preservation Policy Framework" and "Preferred File Formats" documentation for more information about the repository's format policies and practices.

Likelihood and impact assessment



It is difficult to assess the likelihood and impact of format-related obsolescence because it depends on developments in formats, software, and user behavior. With respect to the formats that the Digital Collections have preserved to date, the likelihood of obsolescence is generally low. If obsolescence occurs, the impact could vary from medium to high in relation to the duration of the problem. It can be a low-impact event (not illustrated) when the Digital Libraries Division moves proactively to migrate files from obsolete formats to accessible formats and users move swiftly to update any relevant software. The probability of a low-impact event increases when the formats in use, even though they have been superseded, remain widely known and well documented.

There is a risk that large-scale transformations could cause temporary service outages and lead to data corruption or loss.

While the Digital Collections make every effort to preserve and disseminate formats that meet the needs and expectations of the designated community, the repository cannot guarantee that users have up-to-date and compatible software on their computers. For this reason, there is a risk that some users could experience format-related problems that the repository cannot control.

If format transformation is necessary, the Digital Libraries Division will give priority to maintaining the intellectual content contained in an individual object over preserving its appearance or a specific presentation. Consequently, some users may perceive that information has been altered or lost.

Management strategy

The repository's first line of defense against format obsolescence is its ongoing efforts to preserve and disseminate formats that meet the needs and expectations of its designated community. To this end, the Digital Libraries Division monitors the digital curation field for broad trends and emerging standards, carries out extensive usability testing, and solicits feedback from its designated community.

The repository does not have a prescribed threshold or metric that would initiate format migration. The necessity and urgency of format migration will be evaluated on a case-by-case, cost-benefit basis.

To ensure the integrity of information during a large-scale transformation, the Digital Libraries Division would perform extensive testing, validation, and logging in an isolated development environment before initiating the transformation. After transformation, random samples of migrated content would be examined manually to assess their fidelity to the original. The migration and any related information would be recorded as an event in the preservation metadata for each object and the Digital Collections would retain the original objects in the repository.

While the Digital Libraries Division does not have an explicit list of accepted file types, a documented list of commonly accepted formats and standardized normalization procedures provides a framework. This documentation is included in the Digital File Formats documentation on the Digital Projects Unit's website.

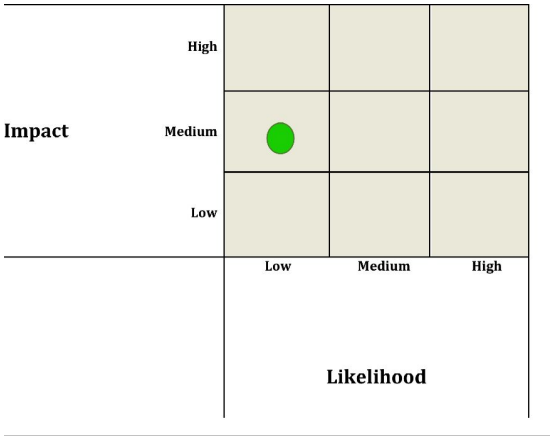
Loss of critical hardware or software support

Dependencies

The UNT Libraries' Digital Collections rely on hardware and software supplied by commercial vendors to fulfill its mission. In particular, the Dell servers, Dell storage arrays, and VMWare

virtualization environments are central to the ongoing operation of the repository. Vendors could withdraw support if they discontinue a product, if their business strategies change, or if they encounter financial difficulties.

Likelihood and impact assessment



Loss of support may not lead to service outages in the short-term, but it could force the repository to carry out substantial migrations. While disruptions may be limited to the repository's administration and maintenance, the large-scale migration of data, databases, or applications could lead to service outages and data corruption or loss.

Management strategy

For servers, storage arrays, and virtualization environments, Lib-TACO works with well-known, commercially-successful vendors who have large user bases.

The UNT Libraries employ a number of experienced systems administrators and programmers to oversee the repository's technical operations at various levels. When hardware and software changes are indicated, they work closely with systems administrators in Lib-TACO to evaluate alternatives, timing, and expected outcomes. For more information about the Digital Libraries Division's procedures for hardware and software change please see sections above.

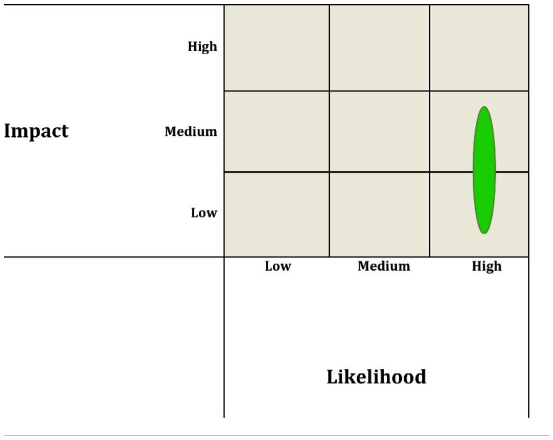
Manmade threats

Operator error

Dependencies

The successful operation of the UNT Libraries' Digital Collections relies on cautious, skilled personnel to design systems, write software, perform routine maintenance, and correct errors. Minimizing or preventing operator error is crucial to protecting the long-term integrity of information in the repository and ensuring the reliability of the organization's services.

Likelihood and Impact Assessment



Operator error is a high-likelihood, low- to medium-impact event. People will inevitably make mistakes in the course of their work, and therefore operator error is a high-likelihood event. The impact will vary according to the systems and information involved. In general, it is unlikely that a single error will lead to widespread data loss or a prolonged service outage. However, efforts to fix operator error may lead to temporary service outages.

Management Strategy

The Digital Libraries Division has automated its critical processes in order to minimize the risk of operator error. Ingest, data management, archival storage, and dissemination are carried out by applications and use industry-standard error detection and quality-control measures.

Lib-TACO grants authorizations and administers access controls with the intention of maintaining a high level of security and stability. The UNT Libraries' Network Manager in collaboration with the Digital Libraries Division authorizes each staff member with limited access to system functionality based on his or her assigned duties. The UNT Libraries: TRAC Conformance Document section C3.3 provides a general outline of the relationship between staff roles and specific duties. Only systems administrators can make changes to access controls.

Only systems administrators and core developers can write changes to the production servers or file system.

Regular fixity checks help to detect unauthorized changes to AIPs, after which Digital Libraries Division staff can initiate recovery processes and revert the AIP to a known good state.

Only Lib-TACO systems administrators have access to the UNT Libraries server room. Only Lib-TACO can grant authorization to enter the facility.

Users retrieve disseminated information from read-only HTTP-based web services and not from the core storage directories as a mounted file system.

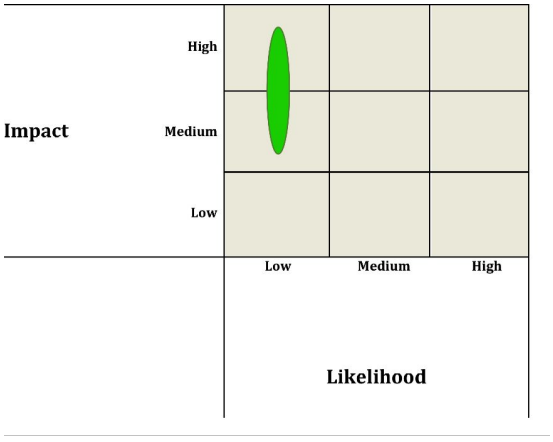
The Digital Libraries Division and Lib-TACO carry out regular backup of data, databases, and applications according to standard backup practices. These backups are intended to serve as the basis for restoration of server infrastructure materials in the event of data corruption or loss. Data stored as part of the UNT Libraries' Coda repository is migrated between two storage facilities, one in the Willis Library, and one in the UNT System Data Center at the UNT Discovery Park research campus.

Sabotage by insider

Dependencies

In order to carry out mission of the UNT Libraries' Digital Collections, the Digital Libraries Division provides its employees with appropriate and limited access to information and technologies that are subject to licenses, agreements, terms of service, access policies, and security controls that are not generally accessible by the designated community. The operation of the UNT Libraries' Digital Collections depends on the discretion, confidentiality, and lawful behavior of its employees.

Likelihood and impact assessment



Sabotage is a low-likelihood event. The impact may be medium or high because sabotage is a deliberately malicious act by an individual (or group) who knows, to a certain extent, how the system has been configured and protected. It may be difficult or time-consuming to identify the extent of the sabotage and repair the damage. Efforts to repair any damage may require temporary service outages.

Management strategy

The Digital Libraries Division reduces the risk of sabotage by offering its employees competitive compensation and benefits, clear and reasonable performance expectations, constructive and practical feedback, opportunities for advancement and professional development, and confidential mechanisms for dispute resolution.

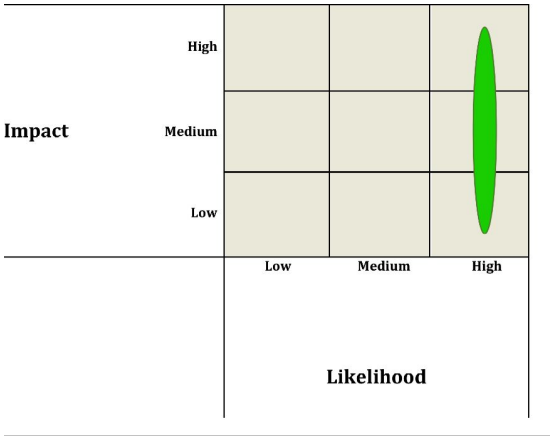
UNT Libraries' Digital Libraries Division's strategy for minimizing unauthorized access to the repository is largely the same as its strategy for operator error. Please see above, for details.

Cyber attack

Dependencies

The operation of the UNT Libraries' Digital Collections relies on the continuous, error-free operation of its technology infrastructure and on the authenticity and integrity of data to carry out its mission and fulfill its obligations. The Digital Collections are committed to ensuring that the designated community can access authentic information in a safe and efficient manner. UNT must have security controls that minimize violations of its access policies and licenses.

Likelihood and impact assessment



The UNT Libraries expect that cyber attacks will occur often, though the impact will vary considerably in relation to the nature of the attack. On the one hand, some cyber attacks will

have little (or no) effect on data or services. These attacks include programs designed to use Digital Collections as a platform or proxy for attacks on other targets. On the other hand, some attacks will affect service in obvious ways, either by impairing performance, causing service outages, or by damaging data. These attacks include automated content harvesting, denial-of-service attacks, and purely destructive attacks. Efforts to close the vulnerability, repair the affected components, and restore data could lead to temporary service outages.

Management strategy

The Digital Libraries Division staff work closely with Lib-TACO personnel to minimize the risks associated with cyber attack. The UNT Libraries use current, widely-accepted, industry-standard procedures to reduce vulnerability and respond to attacks.

Lib-TACO deploys a variety of techniques and tools to monitor the repository's hardware and software. Systems administrators receive information about system behavior and usage from a number of custom-built scripts, a Nagios monitoring program, malware and virus detection programs, and monitoring functionality built into hardware. These tools warn administrators about abnormal activity such as excessive processor loads and slow response times. In addition, staff monitor critical processes, such as ingest and data management, for malfunctions and suboptimal performance.

Lib-TACO and Digital Libraries Division staff evaluate all mandatory and optional security patches and software/firmware updates on a risk-benefit basis. Staff apply all mandatory security patches and software/firmware updates. Staff may or may not apply optional patches or updates.

The Digital Libraries Division and Lib-TACO have network protection mechanisms in place, including firewalls, proxies, packet filtering routers, intrusion detection systems, and malware and virus detection programs.

Regular fixity checks help to detect unauthorized changes to AIPs, after which Digital Libraries Division staff can initiate recovery processes and revert the AIP to a known good state.

The Digital Libraries Division does not limit bandwidth or data transfer volume for users unless there is a clear breach of security or terms of service. Pre-defined limits (caps) can sometimes degrade service for legitimate users. The Digital Libraries Division and Lib-TACO monitor system performance and usage in order to identify and possibly block IP addresses that appear to be harvesting content that causes a degradation in service for other users and may block these IP addresses.

Access policies for the UNT Libraries' Digital Collections are exercised by a combination of IP-based and Local Directory Authorization Protocol (LDAP) authentication that uses the UNT Active Directory system and the UNT EUID authentication mechanism.

Users retrieve disseminated information from read-only HTTP based Web services and not from the core storage directories as a mounted file system.

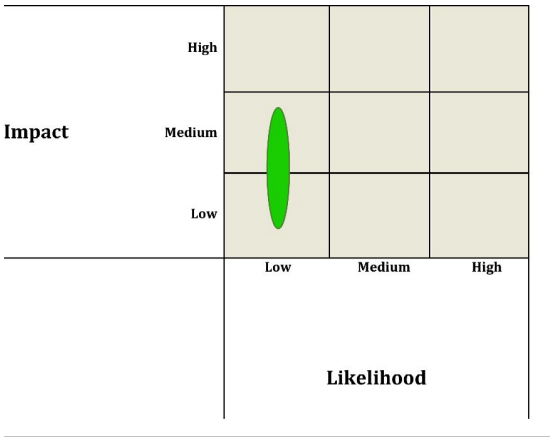
The Digital Libraries Division and Lib-TACO carry out regular backup of data, databases, and applications according to standard backup practices. These backups are intended to serve as the basis for restoration of server infrastructure materials in the event of data corruption or loss. Data stored as part of the UNT Libraries' Coda repository is migrated between two storage facilities, one in the Willis Library, and one in the UNT System Data Center at the UNT Discovery Park research campus.

Physical security incident

Dependencies

The Digital Libraries Division depends on physical security in order to protect its staff and safeguard the long-term authenticity and integrity of its data, databases, applications, and administrative documents. The Digital Libraries Division relies on security controls provided by the UNT Libraries and the University of North Texas.

Likelihood and impact assessment



Physical security incidents in connection with the Digital Libraries Division, its offices and the UNT Libraries server room are low-likelihood events, though the impact may vary in relation to the staff involved and the systems affected. Incidents in connection with other areas of the Willis Library are medium-likelihood, low-impact events (not illustrated).

Management Strategy

Physical access to the Digital Libraries Division office space is managed by the UNT Libraries Facilities and Systems.

The UNT Police are responsible for the physical security of all campus properties including Willis Library. The UNT Police work in collaboration with the UNT Libraries Facilities and Systems Division.

The UNT Libraries Facilities and Systems provide an on-call service for situations when staff or librarians within the library have security issues. This service is implemented as a "Help Me" button available on all staff machines.

UNT Libraries Facilities and Systems coordinates physical security and access control for the Digital Libraries Division administrative offices. Entry to the Digital Libraries Divisions' administrative office is controlled by electronic locks at all hours.

UNT Police actively patrol the UNT Denton campus and visit the Willis Library building as a part of their regular route. The UNT Police are available 24/7 in an on-call capacity if needed.

Access to the UNT Libraries' off-site storage facility for backup copies at the UNT System Data Center at the UNT Discovery Park research campus. is restricted to authorized personnel at all hours. Access to this computing facility is controlled by UNT IT Shared Services.

UNT Libraries Facilities and Systems coordinates physical security and access control for the UNT Libraries Willis server room. Only UNT Libraries Facilities and Systems can grant authorization to enter the facility, and access is restricted to authorized personnel.

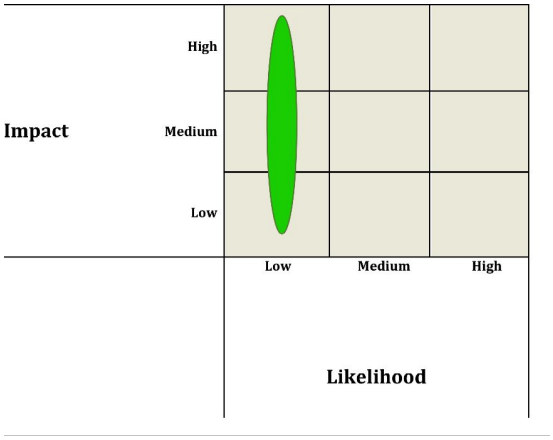
Natural threats

Fire

Dependencies

The Digital Libraries Division offices, work areas, and primary systems are located in a large building and are vulnerable to fire. The Digital Libraries Division depends on fire detection and suppression systems provided by the UNT Libraries and the University of North Texas Facilities Fire Safety department.

Likelihood and impact assessment



Fire is a low-likelihood event. The impact of a fire will vary according to the personnel and systems affected. Prolonged service outages are possible. Even if there is no evident damage to the Digital Collections systems, a fire could force the UNT Libraries to shut down service in order to permit assessment and repair of the facility. A fire elsewhere in the building or on the campus could affect network cables that deliver the repository's information to the internet, effectively causing a service outage for a period of time. A fire in the surrounding region could affect electrical power for short or long periods of time. A fire that prevents staff from carrying out their duties (e.g., if staff cannot access the office) will likely be a temporary, low-impact event.

Management strategy

The Digital Libraries Division complies with emergency preparedness and response procedures designed by the UNT Libraries and the University of North Texas Facilities Fire Safety department.

In the event of evacuation, staff will follow procedures outlined in the UNT Libraries Emergency Manual

The Digital Libraries Division and Lib-TACO carry out regular backup of data, databases, and applications according to standard backup practices. These backups are intended to serve as the basis for restoration of server infrastructure materials in the event of data corruption or loss. Data stored as part of the UNT Libraries' Coda repository is migrated between two storage facilities, one in the Willis Library, and one in the UNT System Data Center at the UNT Discovery Park research campus.

Fire suppression in the UNT Libraries server room is based on heat and smoke detectors and automatic Halon fire suppression system.

The UNT Libraries have fire detection and suppression systems throughout the Willis Library.

Upgrades and expansion to existing wet fire suppression is in the planning/implementation process as part of a Willis Library Mechanical Electric and Plumbing (MEP) refresh scheduled for 2015-2016.

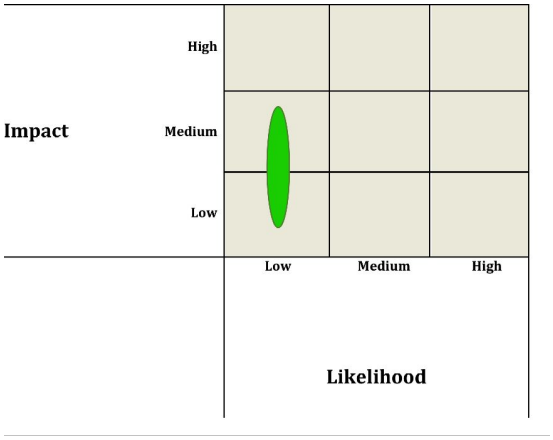
Flood

For plumbing failure in Willis Library, see “Plumbing” below.

Dependencies

In order to ensure the long-term preservation of content and the reliable and efficient dissemination of information to its designated community through the UNT Libraries’ Digital Collections, the Digital Libraries Division relies on stable environmental conditions in its offices, the UNT Libraries server room, and its off-site storage facility. In addition, the Digital Libraries Division depends on stable, continuous electrical power.

Likelihood and impact assessment



Flooding due to rain, snowmelt, or utility failure is a low-likelihood event in Denton and/or the surrounding area. The impact will vary according to the location and severity of the flood. There is low- to medium- risk of physical damage to the Digital Collections because the repository and its technology infrastructure are located on the lower level of a large building. Additionally, flooding in the basement of the building could affect network cables that carry information from the repository to the internet. Flooding that causes extended electrical failures could lead to service outages (see below, for analysis of electrical failure). For these reasons, the impact of flooding may be high (not illustrated). The likelihood of high-impact events is low. Flooding that prevents staff from carrying out their duties (e.g., if staff cannot travel to the office) is likely a temporary, low-impact event.

The Willis Library is located in a Zone X area -- i.e., an “Area determined to be outside of the 0.2% annual chance of floodplain” -- according to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map Number 48121C0360G revised April 18, 2011.

Management strategy

The Digital Libraries Division complies with emergency preparedness and response procedures designed by the UNT Libraries and the University of North Texas. In the event of evacuation, staff will follow procedures outlined in UNT Libraries’ Emergency Manual.

For local water problems, the Digital Libraries Division depends on facilities management provided by the UNT Libraries and UNT Facilities.

The Digital Libraries Division operations are split between the lower level and the third floor of the Willis Library. If flooding occurred in the lower level, temporary offices could be arranged either on the third floor or somewhere else in the building.

While the UNT Libraries Server Room is located in the lower level, several strategies to minimize risk of damage due to flooding are in place:

- All servers are mounted on racks and have uninterruptible power supply (UPS) systems
- Water detection systems alter network administrators if water is present on the floor in the server room
- Power in the server room is positioned overhead and never run along the floor

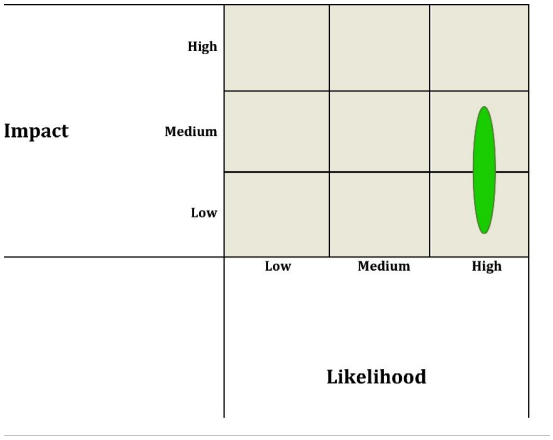
The Digital Libraries Division and Lib-TACO carry out regular backup of data, databases, and applications according to standard backup practices. These backups are intended to serve as the basis for restoration of server infrastructure materials in the event of data corruption or loss. Data stored as part of the UNT Libraries’ Coda repository is migrated between two storage facilities, one in the Willis Library, and one in the UNT System Data Center at the UNT Discovery Park research campus.

Severe weather (thunderstorm, blizzards, tornado)

Dependencies

The Digital Libraries Division depends on safe and typical weather conditions in order to carry out day-to-day operations, safeguard archival storage, and disseminate information via the UNT Libraries’ Digital Collections to its designated community.

Likelihood and impact assessment



Severe weather is a high-likelihood, low- to medium-impact event. Tropical storms, tornadoes, severe thunderstorms, heavy rainfall, heavy snowfall, and other extreme weather conditions have occurred in Denton and/or the surrounding region. The chief risk to the Digital Collections are from weather events that cause extended power failures. While the repository and associated server infrastructure have an uninterruptible power supply (UPS) for short-term operation of the storage array and servers, it does not have a live mirror site. Prolonged power failures could lead to service outages. For that reason, severe weather can be a high-impact event (not illustrated). The likelihood of high-impact events is low. Severe weather that prevents staff from carrying out their duties (e.g., if staff cannot travel to the office) is likely a temporary, low-impact event.

Management strategy

The Digital Libraries Division complies with emergency preparedness and response procedures designed by UNT Libraries and the University of North Texas. In the event of evacuation, staff will follow procedures outlined in UNT Libraries' Emergency Manual.

The Willis Library building is a large, thick-walled, reinforced concrete structure. The UNT Libraries' server room is located in the lower level of the building, away from the above-ground exterior walls and windows.

The Digital Libraries Division depends on power infrastructure and facilities management provided by the UNT Libraries and UNT Facilities. See below for details about the Digital Libraries Division management strategy for electricity-related problems.

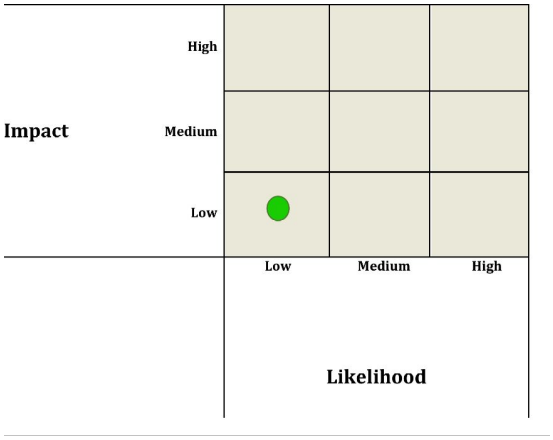
The Digital Libraries Division and Lib-TACO carry out regular backup of data, databases, and applications according to standard backup practices. These backups are intended to serve as the basis for restoration of server infrastructure materials in the event of data corruption or loss. Data stored as part of the UNT Libraries' Coda repository is migrated between two storage facilities, one in the Willis Library, and one in the UNT System Data Center at the UNT Discovery Park research campus.

Earthquake

Dependencies

In order to ensure the long-term preservation of content and the reliable and efficient dissemination of information to its designated community through the UNT Libraries' Digital Collections, the Digital Libraries Division relies on stable environmental conditions in its offices, the UNT Libraries server room, and its off-site storage facility. In addition, the Digital Libraries Division depends on stable, continuous electrical power.

Likelihood and impact assessment



Earthquake is a low-likelihood, low-impact event for the City of Denton. The University of North Texas and the UNT Libraries are located in a location with a seismic design category of Zone A (lowest risk) by the Federal Emergency Management Agency (FEMA).

Management strategy

The Digital Libraries Division complies with emergency preparedness and response procedures designed by UNT Libraries and the University of North Texas. In the event of evacuation, staff will follow procedures outlined in the UNT Libraries' Emergency Manual.

The Digital Libraries Division and Lib-TACO carry out regular backup of data, databases, and applications according to standard backup practices. These backups are intended to serve as the basis for restoration of server infrastructure materials in the event of data corruption or loss. Data stored as part of the UNT Libraries' Coda repository is migrated between two storage facilities, one in the Willis Library, and one in the UNT System Data Center at the UNT Discovery Park research campus.

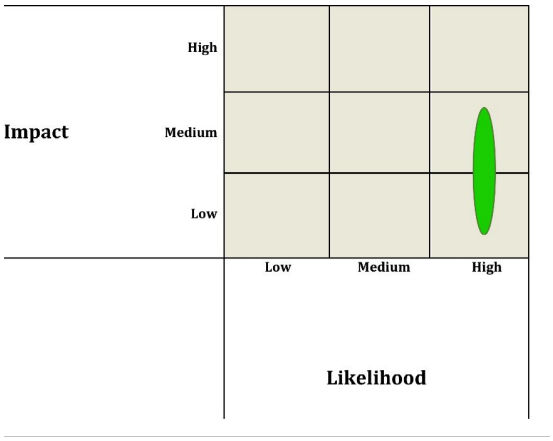
Utility or environmental/building system failure

Electrical failure

Dependencies

The UNT Libraries' Digital Collections require continuous, stable electrical power at Willis Library to maintain the collections, run various services, and disseminate information to the designated community. The repository depends on electrical infrastructure within the building and on the electrical utilities that serve Denton and northern Texas. In addition, the continuity and stability of electrical power at UNT's Discovery Park research campus that houses off-site replicated storage is important for maintaining environmental conditions and security systems.

Likelihood and Impact Assessment



Electrical failure is a high-likelihood, low- to medium-impact event. The impact will vary according to the duration of the power failure. The uninterruptible power supply (UPS) can keep the repository's storage array and servers running for a short period of time. Since the repository does not have a live mirror site, extended electrical problems could lead to service outages. Prolonged outages are low-likelihood (not illustrated).

Power spikes due to lightening strikes or utility irregularities (not illustrated) are a species of electrical failure and could damage the repository's hardware, software, and data. These are low-likelihood events.

Management Strategy

The Digital Libraries Division complies with emergency preparedness and response procedures designed by UNT Libraries and the University of North Texas. In the event of evacuation, staff

will follow procedures outlined in UNT Libraries' Emergency Manual. The UNT Libraries' have an auxiliary power source that will provide adequate lighting for safe evacuation.

Electricity and power infrastructure for the Digital Libraries Division is managed by Lib-TACO and the UNT Libraries in conjunction with UNT Facilities.

The Digital Libraries Division and Lib-TACO carry out regular backup of data, databases, and applications according to standard backup practices. These backups are intended to serve as the basis for restoration of server infrastructure materials in the event of data corruption or loss. Data stored as part of the UNT Libraries' Coda repository is migrated between two storage facilities, one in the Willis Library, and one in the UNT System Data Center at the UNT Discovery Park research campus.

Lib-TACO maintains per-rack uninterruptible power supplies (UPS) for the repository's storage arrays and servers. The UPS provides continuous power in the event of short electrical disruptions. If an electrical failure lasts longer than the battery life of the UPS, the power supply will initiate a controlled shutdown of the systems.

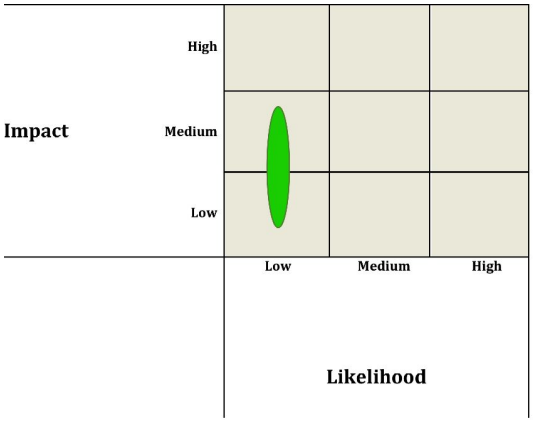
Electricity for the repository's server and storage passes through a power conditioner and protection circuit that ensures stable, clean power.

Plumbing failure

Dependencies

In order to ensure the long-term preservation of content and the reliable and efficient dissemination of information to its designated community through the UNT Libraries' Digital Collections, the Digital Libraries Division relies on stable environmental conditions in its offices, the UNT Libraries server room, and its off-site storage facility.

Likelihood and Impact Assessment



Plumbing failures that affect the Digital Collections are low-likelihood events, but the impact will vary from low to medium depending on the systems involved and personnel affected. Water leaks that contact electrical devices are a serious threat to human safety, and therefore flooding could force the Digital Libraries Division and Lib-TACO to shut down systems until the situation can be evaluated and resolved. The worst-case scenario is water flooding into the UNT Libraries' server room from the floors above. Plumbing failures in other parts of the building could affect electrical power and/or network cables that carry the repository's content to the Internet.

Management Strategy

The Digital Libraries Division depends on facilities management provided by the UNT Libraries and UNT Facilities. Lib-TACO monitors and manages conditions in UNT Libraries' server room.

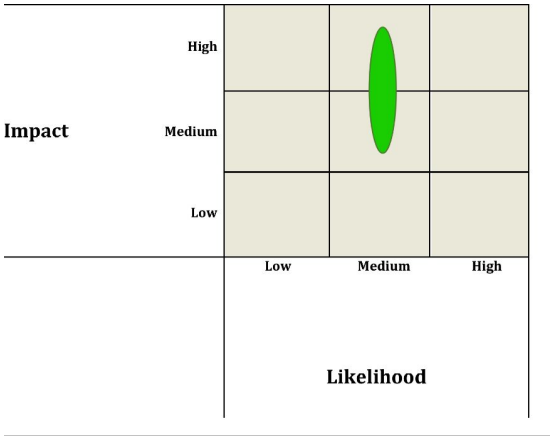
The Digital Libraries Division and Lib-TACO carry out regular backup of data, databases, and applications according to standard backup practices. These backups are intended to serve as the basis for restoration of server infrastructure materials in the event of data corruption or loss. Data stored as part of the UNT Libraries' Coda repository is migrated between two storage facilities, one in the Willis Library, and one in the UNT System Data Center at the UNT Discovery Park research campus.

Server room cooling failure

Dependencies

Cooling of servers and storage arrays is important for the integrity of data, databases, and applications. Server room cooling depends on electrical power for operation. See above for the Digital Libraries Division's risk analysis and management strategies for electrical failure.

Likelihood and Impact Assessment



Heating, air conditioning, and air quality failures are medium-likelihood, medium to high-impact events because they are dependent on electrical power. Any power failure in the Willis Library building or the surrounding region could shut down environmental systems in the Digital Libraries Division offices. Local or regional power failures may shut down systems at the UNT System Data Center at the UNT Discovery Park research campus (the off-site server facility). Temporary environmental problems that affect human comfort may disrupt the administration of the repository but should not lead to service outages or data loss. In the case of a long-term disrupt in power to the server room cooling system, Lib-TACO will shutdown systems so that they do not overheat and suffer permanent damage. Extended cooling problems could lead to service outages. Prolonged outages are low-likelihood (not illustrated).

Management Strategy

The Digital Libraries Division depends on facilities management provided by the UNT Libraries and UNT Facilities. Lib-TACO monitors and manages environmental conditions in the UNT Libraries' server room.

The Digital Libraries Division and Lib-TACO carry out regular backup of data, databases, and applications according to standard backup practices. These backups are intended to serve as the basis for restoration of server infrastructure materials in the event of data corruption or loss. Data stored as part of the UNT Libraries' Coda repository is migrated between two storage facilities, one in the Willis Library, and one in the UNT System Data Center at the UNT Discovery Park research campus.

Lib-TACO operates a redundant cooling infrastructure in the UNT Libraries' server room. There is adequate capacity to operate the cooling systems in the event that one should fail because of mechanical or electrical issues.

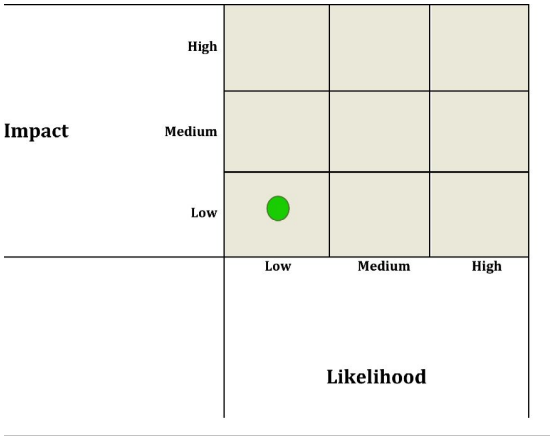
Upgrades and expansion to existing server room cooling infrastructure is in the planning/implementation process as part of a Willis Library Mechanical Electric and Plumbing (MEP) refresh scheduled for 2015-2016.

Heating, air conditioning, or air quality failure

Dependencies

In order to ensure the long-term preservation of content and the reliable and efficient dissemination of information to its designated community through the UNT Libraries' Digital Collections, the Digital Libraries Division relies on stable environmental conditions in its offices, the UNT Libraries server room, and its off-site storage facility.

Likelihood and Impact Assessment



Heating, air conditioning, and air quality failures are low-likelihood, low-impact events. Any extended power failure in the Willis Library building or the surrounding region could shut down environmental systems in the Digital Libraries Division offices. Local or regional power failures may shut down systems at the UNT System Data Center at the UNT Discovery Park research campus. Temporary environmental problems that affect human comfort may disrupt the administration of the repository but should not lead to service outages or data loss.

Management Strategy

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facilities, one in the Willis Library, and one in the UNT System Data Center at the UNT Discovery Park research campus.

If conditions occur that would require the temporary displacement of Digital Libraries Division staff, arrangements can be made for these staff to work remotely.

Upgrades and expansion to existing heating, cooling, and air quality infrastructure is in the planning/implementation process as part of a Willis Library Mechanical Electric and Plumbing (MEP) refresh scheduled for 2015-2016.

References

FEMA. *Emergency Management Guide for Business & Industry*. FEMA 141. Federal Emergency Management Agency, October 1993. http://www.fema.gov/media-library/assets/documents/3412 accessed September 14, 2015.

National Institute of Standards and Technology. *Guide for Conducting Risk Assessments*. NIST Special Publication 800-30 Rev. 1, July 2002. http://csrc.nist.gov/publications/nistpubs/800-30-rev1/sp800_30_r1.pdf accessed September 14, 2015.

Consultative Committee on Space Data Systems. *Audit and Certification of Trustworthy Digital Repositories – Recommended Practice – CCSDS 652.0-M-1*. Consultative Committee on Space Data Systems, September 2011. http://public.ccsds.org/publications/archive/652x0m1.pdf accessed September 14, 2015.

Digital Libraries Division. *Digital Projects: Digital File Formats* UNT Libraries, 2015 http://www.library.unt.edu/digital-projects-unit/digital-file-formats accessed September 14, 2015.

DigitalPreservationEurope. *DPE Repository Planning Checklist and Guidance DPE D3.2*. DigitalPreservationEurope, April 2008. https://web.archive.org/web/20111014181729/http://digitalpreservationeurope.eu/platter.pdf accessed September 14, 2015.

FEMA. Federal Emergency Management Agency, *Earthquake Hazards Maps*, 2015 http://www.fema.gov/earthquake-hazard-maps accessed October 10, 2015

Shallcross, Michael. *The Hathi Trust is a Solution: The Foundations of a Disaster Recovery Plan for the Shared Digital Repository.* Hathi Trust, 2009. http://www.hathitrust.org/technical_reports/HathiTrust_DisasterRecovery.pdf accessed September 14, 2015

UNT Libraries. *TRAC Conformance Document.* UNT Libraries, 2015. http://www.library.unt.edu/digital-libraries/trusted-digital-repository/ accessed October 28, 2015

UNT Libraries. *UNT Libraries Digital Preservation Policy Framework.* UNT Libraries, 2015. http://www.library.unt.edu/policies/ accessed September 14, 2015