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Arthost Questionnaire Summarized Responses

LIMA is the international platform for sustainable access to media art in the Netherlands. LIMA offers digitisation services and advice to museums, artists, and private collectors and has a cross-institutional, domain-specific, digital repository for digital art, where media artworks from over 30 media art collections in the Netherlands are preserved for the future. LIMA has implemented maintenance procedures for computer-based artworks, such as testing equipment, producing backups, documenting software, storage, and checking in its workflow. And an operational repository for digital art.
We are currently updating our digital repository and workflow. With an emphasis on net art and complex digital artworks, our new dynamic repository, collection information system, and associated workflows, should be suited to capturing the mutability inherent throughout the lifecycle of such works. We are conducting a survey of digital art storage practices in the media art world (as Nimk did 7 years ago). This findings will be used to verify our decisions that will be shared within the community of practice. Thank you all for cooperating and thanks to Jim Wraith for reprocessing the responses.

Respondents:

Tate (Patricia Falcao/Tom Ensom)
Ben Fino-Radin (Small Data Industries)
Beeld en Geluid (Arnoud Goos)
MOMA (Kate Lewis)
Centre Pompidou (Alice Moscoso)
Smithsonian Institute (Isabel Meyer/Crystal Sanchez)
ZKM (Morgan Stricot)
SFMOMA (Martina Haidvogl, Lana White, Mark Hiller, Grace Weiss, Marla Misunas)
LIMA (Gaby Wijers, Mila van der Weide, Wiel Seuskens)

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Typologies and Topologies

Basics of collection: what digital art is held and how much of it?

Tate: 11 acquired works, mostly installations, 1 artist website, another 2 or 3 works coming into the collection in the next year. Also a series of works commissioned from 2002-08 to be taken into consideration, their not being acquisitions having put off the need to engage with questions of preservation.
Ben Fino-Radin: Doesn't serve as a hosted repository, with the exception of Cory Arcangel, for whom one physical location of the artist's working archive is kept.
Beeld en Geluid: Digital art is not a stamp we put on things, but we hold material that we think could be considered such: 250 websites/interactive documentaries, 7-8,000 web-only videos, and a couple of dozen games (though almost all physical copies).

MOMA: Approx. 4,000 artworks or design objects, from single-channel video to fonts to video games to computer-based art to traditional art video installation and mixed-media installations. Also have a large film collection, primarily nitrate/acetate, but also acquiring digital films.
Centre Pompidou: 20 computer-based works, 5 online works.
Smithsonian Institute: Our DAMS is the central repository for the entire institute, comprising 19 museums, 9 libraries, a zoo.. stores all types of digital files, with digital artworks one category within this. We currently have 2.7PB of storage on the repository.

ZKM: 121 computer-based artworks in the collection, but collection also includes computer-generated drawings, text, paintings etc. 10% of collection is online/net-art. No websites, only pieces using software/tools online. There's a sound-based collection in the mediatheque, in a separate database.

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SFMOMA: Main media art collection consists of video art (single/multi-channel installations. Recently started acquiring more software-based art, somewhere between 10 and 20 works. Architecture and design department holds some websites from the 90s, but not live.

LIMA: Approx. 3,000 artworks distribution collection consists of 85 % of video art (including single/multi-channel installations) 15 % is software based. Websites of NIMk, LIMA and artists. 5000 documentation and archive as moving image (tape, digitized and online).Approx. 3,000 artworks in DAMS for other collections consists of 75 % of video art (including single/multi-channel installations) 25 % is software based incl. netart.

Data typologies: how are different types of work delineated in the CMS, and what differences occur in the manner of recording their (meta)data?

Tate: Use an old version of TMS [The Museum System], so the overarching classifications are basic: time-based works, and installations. These distinctions may become more fluid with time: an example would be a work in the gallery that uses a computer to search Google for information.

Ben Fino-Radin: Most CMSs shoehorn the diverse descriptive needs into one mould, with the possible exception of the ability to create custom metadata fields. Has developed a CollectiveAccess profile for JODI's archive, but in institutional/private collections such customization is minimal.
Beeld en Geluid: Categorization of objects from the preservation perspective is: audio, audiovisual, 2d images, written documents (all preservation objects), and games and websites (candidate preservation objects). Besides this, there is a split into categories of "News, information and current affairs", "Culture and entertainment", "Amateur and corporate productions", and "The media landscape", with each of these split into further subdomains.

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MOMA: Use TMS: it is set up more for traditional artworks, but time-based media conservators have been working to make it work for media collections. Works are recorded on a component level, so a work consisting of a CRT, a plinth, and a chair would have all of these recorded as their own component. Don't really have any net art, but we have art that calls to the web. Formats are tracked more in terms of component attributes than broad categorizations.

Centre Pompidou: Database is shared by a number of national institutions in France, and is run by an association. Primarily set up for "traditional" artworks, and any changes have to be requested from and negotiated with the association.
Smithsonian Institute: Four metadata models within repository: for images, audio, video, and one for digital artworks. These combine common fields, and fields specific to each model.

ZKM: ZKM previously housed two musea, one for contemporary art and one for digital art. Now merged, digital art being considered part of contemporary art, and presently preparing to merge the databases of the two. Had one sheet for sculpture/painting, and then one for digital artworks. All fields on the database are made available, with those not required being left blank, with the rationale that it is better to have everything on one sheet and possibly not use it all than have something too general.

SFMOMA: Records for media art objects are fairly minimal, used to track works, and to point to further information: technical information is stored separately in a MediaWiki. Some information stored on a Bitbucket server, where it can be kept in a repository with change tracking.

LIMA: Uses a tailor made CIS, set up for video art. Works are recorded on an abstract, manifestation and component level. Sheets for video, installation and channel. Not sure if we need a special sheet for net art.

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How is the topological relationship between a work, its constituent elements, and the different permutations of the same modelled in the data structure? How is the notion of a "version" conceived in relation to a "master" work? Welke type werken worden er onderscheiden met verschillende formulieren?

Tate: Use the components model within TMS, and a graphical illustration of the master and exhibition formats, showing what is made from what. TMS contains one record for an artwork, with components hierarchized from here. Version information is recorded in documentation. Are presently working to develop a structured report for software-based art, and are thinking as to how versions could be reflected within that structure.

Ben Fino-Radin: Chosen approach is to base it on research, to talk to clients and build a typology and classifications to see what works for that given case.

Beeld en Geluid: Base level is 'programme', distinguishable between one-off programmes and programmes part of a 'realisation' or 'series'. A program can be divided into multiple 'selections'. For each 'version' (in the sense of a remake), a new programme is created. For each programme an asset-item is created, with one or more files attached, labelled 'highres', 'auxiliary', or 'proxy'. Depending on preservation strategy, one or two extra copies are kept. For analogue carriers, asset-items are created; the attribute 'archive state' gives the use of the carrier, in terms of archive master or preservation copy or viewing copy.

MOMA: Document at the component level. So a given file would be flagged as having a technical attribute that tells of the format. It is also flagged whether it was supplied by the artist, or is a preservation copy, or exhibition copy etc. Not everything lives in one place, but there is an ecosystem of documentation that can show the history of the work, what components were used, how it was tailored, how it was put together in that iteration.

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Centre Pompidou: Mostly using existing fields and trying to accommodate the needs within the existing framework. Still in the process of trying to document it in the best possible way.

Smithsonian Institute: The units manage their own content, providing DAMS managers with persistent identifiers and administrative data to keep track of. A ‘pact’ has been made with units to divide responsibilities for tasks in terms of creating the packaged data to be stored. System does not natively handle complex nested structures well, so workarounds are used in the preparation and packaging of content for ingest (zip files/BagIt, or disk images). System is set up with a category for original media/files, and a category for distribution/exhibition copies, documentation etc .

ZKM: Model uses an intellectual object to which versions are connected. For example take I Love America by Joseph different versions thereof, with credits, or voiceovers, or subtitles etc. Computer-based works are more complicated due to different states of the art. There is a layer for materials and softwares, and on this layer there are columns, one for the original state of the artwork as purchased, and one for the current hardware and software environments in use. The in-between states are only in the restoration reports, because it would be too much to document on the database all the information between the two moments.

SFMOMA: Presently undertaking work to identify a replacement for present CMS with complex works serving as use cases when discussing with vendors, to best identify how to approach hierarchies, and ensuring disparate sources of information meet up.

LIMA: Model uses an intellectual object to which different carriers/ codes / subtitles are connected. New versions, manifestations : new entry

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Standards

Are known metadata standards applied? What insight can be offered as regards the basis of this choice?

Tate: The metadata being put on TMS is limited, in that it is based on a set of simple, generic standards; data isn't being moved anywhere just yet, so it is not a matter of concern. In thinking about versions of computer-based work, what can be pulled automatically is becoming a standard. Have interest in thinking in terms of what is needed to manage the collection at a higher level, but this is outside of the scope of TMS.

Ben Fino-Radin: Nobody really follows standards verbatim – everything is customized to a degree, maybe from a starting point of CDWA-Lite or Dublin Core.

Beeld en Geluid: Descriptive metadata model is based on FRBR. Preservation metadata is based on PREMIS. Descriptive reference data model is based on SKOS. Archive management process model based on OAIS.

MOMA: Art & Architecture Thesaurus is used for more traditional works. Archivematica used as part of the ecosystem, so all OAIS standards are done through that. There is TMS and Archivematica, and in the middle Binder is used to pull in tombstone information, calls in component attributes and statuses, and pulls information that has been gathered by the microservices in Archivematica, MediaInfo and so on. Everything's wrapped in METS, PREMIS.

Smithsonian Institute: Metadata standards are built on METS, and the system holds technical information, which is added to as necessary with MediaInfo information and the like. When a digital art metadata model was introduced, the first media agnostic model, a preservation section was added on top of the

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METS sections, so fields were available to report on technical information in greater detail. OAIS and PREMIS were looked at during development of the preservation model, so whilst PREMIS isn't used, the data can easily be mapped to a PREMIS structure.

ZKM: For metadata a German-specific version of SPECTRUM (the UK museum documentation standard) is used. It is still to be adapted to include some detail for electronic art, the core task being undertaken in the database now.

SFMOMA: Current CMS uses a stripped-down version of BDWA. We're interested to know if CIDOC CRM has a place for us.

LIMA: Descriptive metadata model is based on FRBR. Archive management process model based on OAIS.

Are persistent identifiers applied? What insight can be offered as regards the basis of this choice?

Tate: TMS creates a unique identifier for a record at the artwork and component levels. This is how components connect to the TMS record, which is like the spine of the system. Archivematica also creates unique identifiers connected to anything done in there. These numbers aren't necessarily those that are worked with, but exist in the system.

Ben Fino-Radin: Has never encountered this: people tend to use conventional art numbering systems, such as acquisition year plus some suffix.

Beeld en Geluid: In 2018 Beeld en Geluid will implement the URN:NBN persistent identifier system, with the aim of creating a sustainable system of references for the collection. This fits the proposal to identify objects at the level of the intellectual entity.

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MOMA: In TMS there's a general artwork number, which can change with the status of the work, but TMS also has a unique ID number at both artwork and component level that does not change.
Smithsonian Institute: Works are identified by an accession number which is fixed by the Smithsonian. TMS is used for artworks, so a bridge has been made between DAMS and TMS (the Collection-DAMS Integration System), so metadata can be pulled from TMS and populated into the corresponding metadata systems in the DAMS.

ZKM: Not presently, but it is desired.

SFMOMA: Not in terms of identifiers for artworks, though perhaps for artists. Do use media art specific numbering conventions to track specific components of an artwork (e.g. master material is tracked with M records

LIMA: Artworks and artists have unique identifiers. In the next version of the CIS LIMA will implement a sustainable system of references for the collection(s).

Are controlled vocabularies/thesauruses for the classification of artworks applied? What insight can be offered as regards the basis of this choice?

Tate: Use more an ontology than a thesaurus, in terms of having a list of operating systems and versions of operating systems, where one can add a piece of software and describe what OS and architecture it would work on.

Ben Fino-Radin: A few different people (Rhizome, Yale) are using Wikidata. There was also a project with the Library of Congress to develop a vocabulary for moving image material.

Beeld en Geluid: GTAA for audiovisual archives is applied to most of the collection. Presently trying to figure out how this can fit new collections (games

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and online videos). Embodies six specific thesauri and controlled lists for personal names, corporate names, geographic locations, two for subject terms (incl. backbone classification), and a specialized thesaurus for genres. Is a collection-based thesaurus, actively managed and LOD conformant.

MOMA: Use the Art and Architecture Thesaurus, but then a lot of data put into TMS is granular, a technical description of a piece on a component level. For example, a computer-based artwork running on an old Mac tower will have a exhibition or backup version running on a separate Mac tower with a disk image dumped onto it. In TMS one would be the artist-supplied computer, and one would be the backup or exhibition computer.

Smithsonian Institute: Units define the vocabulary they want to use, so there's not a specific thesaurus or vocabulary applied, though there are certain metadata fields that have a defined preset list of options. Some fields may be brought over from PREMIS into TMS in the keywords field. Every metadata field in the system is SOLR indexed. The CIS pulls in the data, and this index then pulls everything together.

ZKM: There is terminology for three states of the artworks. Firstly the historical environment with the exact same technologies, so a work on an Amiga 500 will stay on an Amiga 500. Then there is the restored or rebuilt state, which is an equivalent technological environment with small software changs. Finally, there is an updated version with a newer technological environment, with major software changes.

SFMOMA: We have developed many internal vocabularies based on how artists talk bout their works. We don't typically look at published standards. By their very nature, these things change all the time, and we need to be responsive.
LIMA: Using GAMA, Gateway to Archives of Media Art, vocabulary.

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In the case of software-based works, is there a preference in storing compiled binaries and/or source code?

ZKM: Source code is requested when works are bought, though often artists don't like giving it. Presently faced with the problem that a lot of the collection was assembled in the 90s/00s, at a time when there were fewer prevalent standards, so now this work is being undertaken retrospectively, with artists being interviewed, and source code requested. This is combined with receiving between 10 and 30 new software-based works per year, and is complicated by a lot of the information about the older works not being documented, existing only in the heads of the technicians.

LIMA: Yes we prefer to store the source code as well.

Online works

What steps are taken to ensure that online works remain functional, and with whom does this responsibility lie? Do you apply a workflow that you could share?

Tate: So far there is Sandra Gamarra's LiMAC, where the whole website is running on an in-house server, and have disk images for that, treated as an independent virtual machine. Would want to have an agreement with the artist in terms of what could be updated, and how far this could be taken.

Ben Fino-Radin: Helped the DIA Foundation with the condition assessment of several of their web-based commissions, and developed a documentation template so that they could continue doing that work themselves. As far as web-based works, this has primarily been condition assessment, documentation, and preventive conservation. For some artists, depending on the work, creating a

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work file using something like Webrecroder would be an easy first step so there is a contained, static version of that site.

Beeld en Geluid: Presently outsource webcrawling to archiefweb who use a tool called WAD (based on Heritrix3) which creates WARC files for the archive.

MOMA: Have one work that calls data from a dating website, in which case the artists prepared a snapshot of the data in MYSQL database. Requires a lot of work, and is only applicable to a handful of works in a collection of 4,000. In the future it may be desirable to work with artists to do a treatment, getting data from somewhere else and updating software. Depending on artists' wishes, there is also historic information so works could be hermetically sealed and data called from what it is now not a live site.

Centre Pompidou: Presently working with IT department to make backups of works received, their OS, required software, which happens at the time of acquisition or when curators do an inventory. This is mostly documentation and backup, but are trying to build a system to ensure maintenance and regular alerts.

SFMOMA: Workflow around complex media works not well formalized. Upon acquisition, media brought in with assistance of artist and vendor. Bi-monthly quality control sessions held where elements are watched, ran through MediaInfo, and a data-sheet filled. Checksums are verified, Bagit prepared, material uploaded to repository, and hard drive(s) rehoused for storage.

LIMA: Intake questionnaire and control in place. Developing storage service for net art. without harvesting. Browser emulation in cooperation with Rhizome.

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How do you deal with dependency on other resources like Google/Chrome plugins Facebook API or 3rd party software player?

Tate: The one dependency in a work [aforementioned work using Google APIs], started on one API which was updated, but now just uses the Google search engine – the artist was showing the work all over, and had a MySQL database with the results that could be used in the case of places where connectivity may not be so good. So one approach is to have an offline version, and then think about the online version.

Ben Fino-Radin: One of the works documented for DIA was interfacing with several Google APIs and touching live data and there was machine learning involved, so getting a snapshot is only useful so far. The best thing one can do is create a kind of anatomical diagram of the work, a schematic of its inputs and outputs and engines and dependencies, and document that well. Make documentation that can be understood by a conservator, a developer, a technician – something that is communicable and understandable by a layperson, but is also useful to a technician.

Beeld en Geluid: Is being looked at for next year – Beeld en Geluid have been archiving websites for some time now, but are at the point where a 2.0 version of web archiving is required.

ZKM: Are dependent on technical change, and hoping for future research. For example Net Art Generator from Cornelia Sollfrank is working with the Google API, so each time Google make a move adaptation is required. The recent move to IP certification created a problem as the free version of the API is limited to one hundred requests. The artist is unwilling to pay for the commercial version, so a hack has been put in place whereby the IP changes every hundred requests. Google gave their blessing to continue with this on the rationale that

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nothing harmful is being done - companies being accomodating in this manner would be a great help in continuing access to media art.

SFMOMA: Example of Hans Haacke's News, which has been through several iterations. In the software itself, written in node.js, we have a manifest file written in JSON. It also tracks dependencies, and we can lock the versions and store those, and using the software version control software linked to the MediaWiki we can have branches, and can rollback changes.

LIMA: Documenting dependencies. The support of companies would be a great help in continuing access to net art and media art in general.

How do you keep licences of 3rd party software. Software and operating system can become obsolete.

Tate: Are presently collecting OSs and libraries, with licence keys stored in TMS and within artwork folders, though generally if remote servers for a software go down then the software will be unusable anyway. Interesting example given of the UNITY engine, for which only a monthly or yearly licence is available, at which point nothing is really available to store.

Ben Fino-Radin: Suggests emulation in the case of obsolete operating systems and software.

Beeld en Geluid: Do not keep licences. Try to use emulators that do not infringe on copyrights or patents, meaning those that do not require original ROMs.

MOMA: For operating systems, keep them in digital repository and potentially buy the licence. In case of design objects, for example of a CAD file that runs on Rhino 2, would try and acquire the software when the object itself is acquired.

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Smithsonian Institute: Do not manage licences at the repository level, trusting individual units to have obtained proper licences when preparing packages/disk images. Rights issues especially complicated given their being a federal organization.

ZKM: Emulation too time-consuming, and migration only done on a small-scale (e.g. from one classic Mac to another). Some more obscure/unique platforms represented in the collection are unable to be emulated at all, leading somewhat the decision to maintain the historical state. In some cases, software licences prove to be machine-specific in a way that defeats attempts at migration. In some cases, companies such as Cycling ‘74 (creators of Max/MSP) have unlocked versions of software no longer supported, which can prove a great help.

SFMOMA: It is a pertinent question: if we acquire 3D-printed works they often have files from a range of CAD software that we would need the licence for, and that may not be available. As regards copyright law, we have a strong fair use argument.

LIMA: Are presently collecting and storing the software related to the artworks we take care of.

When preserving websites for access, do you use one (virtual) server per website?
Ben Fino-Radin: It depends: if it is early net-art with static HTML, there is no reason, but if there is server-side code it would be very sensible. Virtualization would be a suitable approach to maintaining a larger collection of hundreds of works.

Beeld en Geluid: No question of (re)hosting works, as they are not presented to the public for reasons of copyright/auteursrecht.

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Centre Pompidou: Host sites themselves but also have a collaboration with IRCAM; however, the responsibility falls within the purview of the IT department.

Smithsonian Institute: All based on physical servers: was decided that using virtual servers for daily production work was not going to be sustainable.

ZKM: For simple websites, several of them are hosted on a virtual machine. For more complex works or projects there is one virtual machine per website, or in extreme cases, multiple virtual machines. Work also with Docker technology.

SFMOMA: Only two so far. One has lost its domain, and is now at agentruby.sfmoma.org. Lesson learned! For Learning to Love You More we have it on auto-renew with the registrar. This is an administrative challenge.

LIMA: Yes.

Where do you register your domains? Is there one party that can handle all the top-level domains in the world?

ZKM: Are connected to the Bellevue [?] which is the national high school network, with all domains are registered there. They support .com, .net, .art, .info, .eu, .schule, .information. At ZKM we have .de, .art, .net, and .info.

LIMA: Using TransIP for regular domains (.com, .org, .nl enz.), for more obscure ones (.work etc.) we use 101domain.com

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Linking repository storage and CMS

What linkages are made between the CMS and the repository/digital asset management system? What software(s) are used to facilitate this interoperability?

Tate: Only connection between TMS and Archivematica is through the shared artwork number. Is hoped that Binder will bring together information from both systems.

Beeld en Geluid: None as yet, but are implementing a new system called DAAN [Digital Audiovisual Archive Netherlands].

Centre Pompidou: Has no DAMS, but have developed an in-house database to overcome things missing in regular database, allowing for the extraction of information from the database and the linking of digital files to data entries. This allows entries on the version level, allowing for better handling of historical documentation on the item level.

ZKM: Has a DAMS called Mass, and a CMS created with FileMaker. Metadata recorded in the CMS are automatically updated and transferred to the DAMS on a daily basis, so that it can be linked to the respective work. In the long run a new ID system is to be established that provides a unique cross-database ID. It is hoped that all of the systems - database, CMS, DAMS, servers, issue tracking system - will be able to communicate with each other, but so far this is a work in progress.

SFMOMA: No real automatic links. CMS (Embark) pulls images from the DAMS, but this isn't where the actual repository elements exist. There is no connection between the CMS and the art vault, and no link between the CMS and the MediaWiki. Repository is just folders and files.

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What linkages are made between the CMS and any extant access platform (be it for internal or external use)? What software(s) are used to facilitate this interoperability?

Tate: There is a connection to the website through the DAMS, using a content management system. With Binder it is possible to give remote access, so it is possible to give credentials and provide access to viewing copies etc.

MOMA: There is an internal DAMS which all photographs/artworks are stored in, but are also pushing a viewing file so curators can have access. Speaking to websites, TMS pushes some basic information to MoMA's website (catalogue number, image of the artwork, some other minimal information).

Smithsonian Institute: System is very much an internal one for staff use, though delivery mechanisms for A/V material are present to allow convenient pathways for preservation/presentation work.

LIMA: There is a connection to the website through the DAMS, using a content management system so we can give remote and online access.

Archival storage

Do you use LTO for storage? if not what do you use for archival storage?

Tate: LTO6, managed by Arkivum.

Beeld en Geluid: Yes, an Oracle system called DIVA.

MOMA: Has two robots, one on-site in Manhattan, then another in Queens. LTO robot also produces escrow tape which, when a specific number of artworks have been entered, wraps them in LTFS software (by Arkivum), which tape is then sent to cold storage vault in Hamlin, Pennsylvania.

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Centre Pompidou: Yes, alongside servers for exhibition files, lower resolution access files for documentation, and backups for conservation purposes.

Smithsonian Institute: Everything is stored on spinning disc (EMC Isilon), though backups go to an IBM Tivoli tape archive.

ZKM: LTO6. Capacity 2.5TB. Tar archive container. LTFS. Write two sets of tape, held in different locations.

SFMOMA: LTO5 tapes made from work files, stored off-site with Iron Mountain.

LIMA: Yes but no robot, researching at the moment in cooperation with NDE and EYE a collaboration in this.

Do you use a LTO-robot? if yes How do you control the LTO-robot (standard solution which brand?, custom made)?

Tate: Have two, one at Tate Modern and one at Tate Britain. Managed by A-STOR, with the entire system managed by Arkivum who are responsible for tape replacement and quality checking. Third storage location in Dean Hill, near Salisbury.

MOMA: Hardware and LTO is all IBM, with an archival management layer provided by Arkivum.

Centre Pompidou: Yes, a NEOxl80 shared with the whole institution, not just the museum. Used for the storage of conservation copies, and managed by an external vendor, MTI France SAS.

Smithsonian Institute: Have two copies on spinning disc, and then we make three backups on the Tivoli archive, one of which is off-site. Functions similar to

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LTO. On ingest, EMC Isilon maintains mirrors, duplicated on physically distinct Isilon clusters. Entire digital repository backed up to Tivoli archive, three copies of which are maintained.

ZKM: No.

SFMOMA: Manual. Files stored in LTFS.

LIMA: No.

How do you store more complex works? As a whole system (how do you deal with updates?) or Separate files to rebuild the system?

Tate: Both, as much as is possible. Usually two systems for each artwork are held, one built from scratch, and then a backup. Disk images are taken from the artist's original computer, which is then used to try and set up appropriate virtualisation/emulation. This serves as a good way to identify necessary dependencies.

Ben Fino-Radin: Dependent on complexity. For example, in case of a web stack that is involved to set up, it would be advisable to store a virtual disk image (as well as other parts and documentation). In some cases of an installation being installed for the first time, a disk image is made and an exhibition copy of the computer itself assembled. In some cases moderations are made for ease of day-to-day use (e.g. startup and shutdown scripts).

Beeld en Geluid: Games stored as disk images, websites as WARC files.

MOMA: Decisions made on a case-by-case basis. Hoping to work with disk images in the future, but still thinking about formats, sustainability and access, and the documentation requirements thereof. Also requires thinking about what

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is the work? Use BagIt now, but raises the question of how to BagIt a computer, or a complex software-based artwork?

Centre Pompidou: Handled on a case-by-case basis, with works revisited when needed for exhibition. Looking at more secure and efficient ways of conserving and showing works, but as in many other institutions the IT department has a number of other tasks at hand.

ZKM: Documentation is stored on one server, then all related database where all information is placed, and another server stores backups of software environments, and then there is physical storage of the machines themselves. Server usually stores exectutable, disk images, and source codes as far as is possible. In terms of hardware, spares are bought as and when possible to buy time, and to allow for the installation of backups so as to identify any problems before they become urgent.

SFMOMA: Example of working material from creator of original Apple Mac icons: built Linux virtual machine for data pulled from discs, creating a viewing environment for curators. Original disc images stored on a different server.

LIMA: Both, as much as is possible. If possible two systems for each artwork are held, disk images and separate files.

Do you apply hardware storage of computer-based artworks (cloning of artist's computer and storage on cloned computer) or storage of disk image in digital repository or both?

Tate: Previously computers would be received and displayed, but more frequently works are coming in as packaged executables. Presently seeking budget to buy the computers, to serve at least as an artist verified proof.

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Beeld en Geluid: No focus on hardware: other institutions in the Netherlands are already doing this (cf. National Computer Museum). Rate of change is high enough to make question of replacements/spare parts difficult. When something is to be exhibited it is more desirable to work with wider communities where a lot of hardware preservation work is already done, such as the gaming community.

LIMA: researching options

What provisions are made for the recording and/or storage of external software dependencies for software-based works?

Ben Fino-Radin: Taken on a case-by-case basis, and generally goes into conservation reports or condition assessments. If there is a significant dependency that would break the artwork were it not to work, is it added to the documentational anatomy of the artwork, be that a wiring diagram, logic flowchart, or written narrative.

Beeld en Geluid: Will be looking into this in-depth over the next year, looking at ways to record in metadata information about the software environment in which a game was played, as well as recording the emulation software on which the game runs at the time of ingest.

SFMOMA: (re: News) All modules are stored in a folder, but manifest file previously mentioned refers to all these and can presently automatically download them all. Better to keep them for future-proofing purposes.

LIMA: Will be looking into this in the next years.
Further Comments

MOMA: “I think we’re at an exciting moment with these works, it is such a big shift into the world of the repository, and virtualization. The storage and complexity of that storage is really interesting. I hope that in the next six months

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our repository is robust and we can start getting the works in, then we can really explore what does it mean to have a digital repository, and what does it mean to access the art and the information in a different way. We want to serve up our artworks to our curators, we want them to see a viewing file, and we'd like them to be able to run a virtual machine.. I think we're on a cusp and I can't wait to have this conversation in two years time sand see how, through centralizing our repositories, we then grow our repositories in different ways. To have your idea of this dynamic repository, to then do all these other interesting things, and maybe simplify our lives slightly!"

Centre Pompidou: "What is obvious is the need for certain skills and certain positions. We are trying to share and gather information, but it is hard to create new positions. I never thought I would work so much with IT people, for instance, when I was more in the restoration side. There needs to be more of that, more dialogue between jobs that were previously not talking together and were not connected. It would be nice to have one person in the IT department specialized on this aspect of things, and working in dialogue with someone on the museum side."

Smithsonian Institute: "We are a centralized archive, but being pushed more and more as we build these systems and processes to build a sustainable system that benefits everybody. It would be interesting to talk about net-art and how IT fits into that. As opposed to, I get a disk image that needs to be back in the gallery.. it's always going to be removed from IT at the moment it needs to be on display. […] We have now this process where our digital ecosystem is now centralized, so that IT take care of that and we can use these tools. For the data, we have a layer we call EDAN [Enterprise Digital Asset Network], which is basically a giant index of all the stuff that's pushed to the public, so we have a central aggregated search site called CollectionsSearch. Because all of the vocabularies are so different they have built mappings from all of these into a

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central mapping, so there's a middle layer and I think that has worked really well for us."

ZKM: "We're going to launch a website at the end of this year, I think it is going to be useful for all of us: we're going to share every technical problem we have, and every solution we found. We're going to make it copyleft and give everything to the community, so when we find a solution every museum can read it. And also, open questions like "we have no clue how to have this licensing problem with Macs" and so we open the question, and other museums and other technicians can look at it, also the whole web community. I thought maybe there are other technicians in other museums somewhere who have had these issues, so if we had this help where everybody could share, the arts could maybe survive a bit longer.."