Moderators: Nathan Hall, Jenny Johnson,

Participants: Stu Snydman, JD schaumberg, Tom Rieger, Adam Summers, Doug Boyer

* 1. **What resources are required to set up an all-encompassing 3D/VR program (position titles, IT infrastructure, imaging hardware types, software)?**

“Comprehensive” is a troubling terms, because there are differences based on

Model 1. stanford: “getting started on photogrammetry.” cheap cameras, small collections, lighting, turn-tables, existing staff, targets. . then step 2 - “david” structured light scanner, rented “spider”... each step made a case for next incremental step of technology. A big part of having a program is starting with use cases among researchers/educators--who had questions

Model 2. IUPUI - started a bit bigger $17,000 hardware -

JD - micron level accuracy and resolution need for car and airplane design. Work with variety of manufacturers. Asking questions like what are museums trying to capture. Ended up with Creaform go-scan. Variety of hardware and software. -- institution needs correct hardware with appropriate computer processing. How are they going to archive and preserve data? Are they going to just keep the access file, or do they want to continue to manipulate the .stl file? Staffing: who is going to manage updating and training. Likes to avoid IT staff since it is a closed system, but if they want redundancy of data.

Decisions about Bandwidth

Decisions about what to retain and how much to retain

Sliding scale of needs from small, just getting started - to scaling up to TB per week with data management decisions about which aspects to back up,

Documenting what levels of sampling, geometric accuracy, color accuracy, texture, reflectance,

Knowledge/documentation of benchmarks for different types of imaging.

Adak Summers - Team of GAs generating huge amounts of data, but in absence of data management guidance from library or elsewhere.

From industry side, hardware is defining file type and software.

Adam - data is already heavily derived, massaged, etc before dryad deposit. Lots of need for library services to store and manage research data

* 1. **Common principles of digital preservation advocate for formats that are open, non-proprietary, with broad user/community support, and lossless compression (e.g. TIFF, MKV). Access formats tend to rely on similar criteria, but with lossy formats rather than lossless formats (e.g., jpeg, mp3, What are the best formats in your community for saving 3D image data for access and preservation?**

Adam: save everything. Raw data in CT. every format along the way. Because there may be a better way to reconstruct it in the future.

Archive all data sets, make accessible copy available, with option to request raw data. But this also boils down to use case and availability of resources

When possible, and depending on use case need to keep raw because some items are expensive, some are fragile, some are dangerous, some are ephemeral.

Formats: focus on lossless compression. TIFF, DICOM, BMP, PNG,

BMP - preferred output for skyscan, DNG

OBJ, STL access are heavily processed

Point clouds are important to save

There NEEDS to be an iso standard for 3D, so that even if standard goes away it can be reverse engineered

* 1. **What are the best image capture methods for your respective communities? How do the features (texture, material, reflectivity, transparency, shape, size, color, volume, granularity of detail) of your image subject affect choice of image capture method (laser, structured light, photogrammetry, CT, LiDAR, multi-modal)?**

TIF → [magic] → point cloud → mesh → [magic] → model.

This is partly because the math has improved so much

Statement gauge r&r repeatability for inspection and quality control

Peter Falkingham blog on on resconstructing models from TIF and comparing methods

Next steps - really need data management guide for reseacrhers and GAs.

Really need 3D model viewer on par with IIIF universal viewer, version 3 will hopefully handle non-image formats (including 3d models)

Community College connection. Training professionals& para-professionals for 3D

**Robert-Group on 3D/Scanning and Modeling Questions -**

**Day 1 March 1, 2018 - 9:30-10:30**

Group Members: Scott (Arc Project Non-Profit) - Jennifer (WashU) - Angel (Yale/SDSU) - Rami (commercial) - Jon (Smithsonian) - Kristy (UCSC)

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(Scott) - Photogrammetry Team at Arc Project - crowd-sourced photogrammetry for certain things that have been destroyed

Scott (non-profit) - come at it from post production angle working in hollywood for a long time - cultural digital preservation - need to know what original is and what is the artistry in the rendering

Rami - must have for VR

**VR Experience**

Positions - Unity/Unreal Developer (C#), Texture Artists (Substance), 3D Modeler (Blender, Zbrush, Maya)

IT Infrastructure - VR Ready PC (Rec. GTX 1070+, i7), Oculus/Vive **OR**  Cell Phone + GearVR / Cardboard

Imaging Hardware - DSLR, Laser

Software - Unity, RealityCapture, Blender, Substance Suite, Adobe Suite , Agisoft Photoscan , Zbrush , Knald or Xnormal, Meshlab, InstaLOD

Would add to the skillsets for digital preservation along with IT infrastructure -

Scott - Two people on photogrammetry team (expert photographer - texturing artist) at ARC

3D Modeler - might augment a model - touchups - holes and other items that have not been scanned -

Need to document all of these 3D Touchups -

Jennifer - User Experience for VR

* Capturing in 3D and preserving it over 30 years of collection
* Using MESH Lab and GEOMagic

Jon - structure of program  - director - technician - informatician - entertainment artists have a deep knowledge set this is based on the same technologies - not hiring the entertainment artist in the IT Sector - lots of these artists are freelancing (art station is a place to get freelance artists) -

Institutional disconnect about the types of people who will make up a team - educational side of things about how to build a VR Team  -

Discussion of what it take to build a VR Team

Can libraries hire teams on consulting basis - have a PM expert in the library -

More granting agencies have this as something - incorporate student engagement -

Collaboration with other departments - not possible at all libraries - creating content - backup of content in the workflow -

Angel - understanding the organizational structure of the particular institution and roles of the team in working with VR - piecing together funds from different areas - being in charge of the group - who reports to whom? This needs to be balanced out - educational value and contribution of the team -

(Kristy)  - White light scanning or laser light scanning capture - capture and post processing can be separated out  - Middlebury clay models as example -

How does documentation happen in Arc or other places?

* Not a natural way to document - email with pictures to show the difference between what was captured and what was enhanced
* Technology is changing - most important is to preserve the raw data then ready for changes with technology
* Arc - captured locomotive train - refurbishing old train for film commission - digital asset from the train to use in other movies and projects - did not metadata tag all raw images -
* Need some kind of way to map areas that are original vs those that were touched up

How do you approach copyright for this?

* Arc working with CC licenses on content
* Lots of crowdsourced photogrammetry has same angles - reached out to them to see if they have other angle shots to use
* Editorial (can publish as edits) or Extended LIcense (can republish in any way) - Turbosquid.com (shows rights) -
* Angel - Working with communities - ownership is with the community - can you make it available openly or otherwise - need provenance in the models in order to understand where the original photo objects came from
  1. **Common principles of digital preservation advocate for formats that are open, non-proprietary, with broad user/community support, and lossless compression (e.g. TIFF, MKV).  Access formats tend to rely on similar criteria, but with lossy formats rather than lossless formats (e.g., jpeg, mp3, What are the best formats in your community for saving 3D image data for access and preservation?**

Most tools are closed and a giant black box - but then can derive a shareable version of that - reproducibility will be an issue - need raw data

Angel - Publication discussion - can make the difference between what is proprietary and what is open?

Rami - VR

**FBX , OBJ**

**FBX provide a lot more flexibility in Unity/Unreal. They also have Textures + Materials linked, making it much simpler**

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Angel suggested to add methods to the 1:15pm discussion on storage, access and management.

Rami -

**Indoor / Small - CT,  LiDAR, Photogrammetry**

**Outdoor / Large - Videogrammetry, LiDAR, Photogrammetry**

* 1. **What researchers and practitioners require penetrating 3D scanning technology (e.g. CT scanning)? Would researchers and instructors in your field benefit from the volumetric data output by such scanning techniques, assuming cost was no issue?**

Everyone would love this but the costs are prohibitive -

Open source platform that will work for everyone

Rami - VR

**Medical / Artifacts.**

**CT’s allow users to interact in VR in a brand new way.**

[**https://www.youtube.com/watch?v=xPw6vLnNuSg**](https://www.youtube.com/watch?v=xPw6vLnNuSg)

Vincent - Pipeline development

Question C.: Image Capture

Jarrod (creaform): what do the communities need?

Vincent (SI: How do you preserve that data? We started with photogrammetry because the formats are not proprietary.

Carla (CHI): what’s the transparency of the data? You can convert from proprietary > open, do you lose information about creation process. We focus on principles rather than rules. Different purposes. Work with computational photography. Understand what was added and what wasn’t. Image set as raw data; that’s what you preserve, because you can reprocess it. If you properly capture your image set (training is important). If you give me your data, and you follow a set of rules; capture is independent of software.

Jarrod (creaform): Your community has a higher standard than other industries and applications? You want to know the quality of the data.

Vincent: Need to understand the algorithmic hole filling, need to know the history of the file was processed.

Jarrod: no measurement is perfect; you have to set some specifications.

Carla: Just because you use a high precision instrument, doesn’t mean that the output is high-precision.

Vincent: “The Golden Thread” method doesn’t exist in the 3D world at all.

Carla: QC people don’t care about data 100 years from now. In the case of at risk heritage and sites, different requirements.

Ed: (Duke), expense of capture; level of anxiety at the beginning of a project.

Carla: Should use RAW, you have more control over that data. Recommend DNG for archive format; then make working files; sometimes JPEG, but don’t shoot as JPEG. Computers and software, but you need the methodology. Valid reasons to use scanners. Goes back to core principles of transparency. We need to know what processing was happening.

Liz (Baltimore Libraries): Documenting the context is important

Carla: Depends on application and research context. Context helps explain why the data was created and how.

Jarrod: You want “truth in data.”

Carla

Ed: README files are a minimum. If you don’t embed it, then at least have a file. Technical metadata.

Jarrod: having too many files, and need to organize them.

Ed:  How do you balance overly retentive metadata capture and the ability to get the work done and produce 3D models.

Carla: I think we need more than that. “Capture Context” tool, captures the context of the imaging moment. Produces linked open data, stored as an RDF file in xml. There are a couple of required fields. You can capture info about stakeholders, who was there, equipment used; project level information. Once you’re setup, you are going to produce in a similar work.

Second, “Image Inspector,” will check files (RTI, photogrammetry); looking at metadata in XMP, exif; transformation metadata (set of rules to validate for scientific imaging). Creates human readable html report.

Liz: It would be good to have something similar to exif data for capturing other capture data, etc.

Carla: Using, CRM-dig for provenance data; whatever you filled in will be mapped. Expanding to other formats. CRM-dig is seeing more uptake in U.S., but need other formats. Building an **archive tool** to wrap METS.

Expand to other types of 3D capture data types?

Ed: How do you do a URI’s for a model you created?

Carla: Is not resolved issue.

Zhiwu: You need a standardized packaging model; that is open.

Ed: Will GLtf work?

Zhiwu: There are too many models right now. Need to adopt a common one.

Liz: The better format doesn’t necessarily work out.

Carla; We need to focus on principles that good practice requires.

Question B.: Common principles of digital preservation for formats?

Carla: f What’s the set of things you want to consider when

Zack: so transparency is a big principle?

Liz: You can be **transparent** if you aren’t documenting

Carla: Choice of technology is dependent on **fit for purpose**; precision and resolution is going to very depending on the project goals / research questions.

Carla: Many instruments capture in proprietary format, so what’s the principle there? Is there some way to characterize that data? As a manufacturer, is there a way to indicate what’s been done before you export?

Ed: Can you tag the holes?

I want the polygons to be red where the holes were.

Jarrod: If you do photogrammetry, you may have holes. You can go back to the raw data and see what you did.

Carla: You don’t need to tell us about the algorithm, but need to have a record.

Zhiwu: If you can log what was done.

Jarrod:

Resolution versus accuracy (belief of the user, based on methodology).

Precision (quantifiable based on uncertainty).

Jarrod: Commercial product could report back precision, resolution, etc.

Z: can we do that? Can we output an XML file from that?

Carla; humidity can impact laser results. How much this stuff matters depends on the purpose. If you’re working with endangered data, it can change your workflows and considerations.

Liz: We are not even talking about motion capture!

Example of capturing an old wood lathe.

Carla: PhotoScan has good reporting; calculates uncertainty.

Use calibrated scale bars, accurate to 1/10mm.   Coded targets. Different sizes.

Ed: use total station; signal dot and crystal. Csv file filled with geo referencing data.

Jarrod: have you reproduced the photoscanning calibration results?

Carla: Getting x2 results which we are stating.

Ed: It’s about context. Real world coordinates.

**Main Takeaways:**

**Principles:**

Technology-agnostic solutions; the principles need to be correct.

Transparency and Methodology (not just tech solution, but we need new tech solutions, too.)

Fitness for purpose ; trade-offs (equipment, training, cost, time) for different applications.

Smithsonian and CHI collaborating on Metadata.

CHI’s new toolset being released as open source

How to communicate with tool designers?