Big Ticket Request: Digital Humanities 3D Setup

Summary/definition of 3D terms

I propose a dedicated setup for digital humanities 3D *scanning, modeling, and printing* as research and teaching:

1. **3D scanning** lets you capture a three-dimensional digital model of an object such as a spacesuit or a model plane (much like a flat scanner lets you capture a two-dimensional model of a book page).
2. **3D modeling** uses that scanning to create a digital object you can manipulate, label, and otherwise augment on a computer. (*3D models don't necessarily need to be printed to be useful; for example, we could scan a model airplane propeller and then create a digital animation of the propeller in use.*)
3. **3D printing** produces three-dimensional physical, tangible objects representing either actual artifacts or visualizations of data:
   a. **Artifacts**: Print out in plastic (or other materials) a three-dimensional copy of the original object (or a miniature, magnified, or otherwise altered version) for display and handling, further research (e.g. with previously hard-to-decipher engravings or texture), and experimentation (e.g comparison of behavior of historical airplane propellers by printing and powering miniature versions).
   b. **Visualizations**: Digital files can also be created from scratch to produce 3D visualizations such as timelines, graphs, globes, and scale models (e.g. create a 3D model of a historic satellite orbit that can be viewed from multiple angles).

The DH Center's 3D printing setup would support *research*, with a focus on how to best scan, digitally model and animate, and print facsimiles of archival and humanities artifacts for research and teaching use. Much of our time will be spent experimenting with scanner, printer, and software settings to produce accurately representative 3D models, and it is critical that researchers have full access to the equipment to do this.

Requested funding: $7596.98 (see budget below)

Questions: Amanda Visconti (aviscont@purdue.edu)

General plans for the 3D Setup

1. **Initial internal experimentation:** A one-year initial trial period will focus on experimenting with ASC artifacts suggested by the archivists, and on documenting best practices for creating accurate and useful digital and physical facsimiles for use in further DH research and teaching.
2. **DH project use:** After this trial period, we will also begin to support humanities projects around campus that require our specific setup rather than the Engineering Library's current printing service (e.g. a history class where students digitally "repair", extend, label, or animate historical artifacts using a computer). This outreach will be on the same case-by-case basis as other collaborative projects proposed to the DH Center, rather than as a drop-in service.
3. **External collaborations:** (grant project idea)

Location
The setup will be located in the future DH Center; until that space is inaugurated, the setup will be located in the DH Specialist's office (table along the wall opposite the door).

IT support
IT for the setup will be entirely supported by the Digital Humanities Specialist (installation, support, maintenance). The DH Specialist would develop a contract with Libraries IT to record this understanding. This is an excellent test case to create a workflow for DH in the libraries that includes DH control and support for software, hardware, and policies.

ASC support
I have discussed a possible 3D setup with ▓▓▓▓ (colleagues) ▓▓▓▓ in the ASC, and they have helped me identify specific artifacts and collections that would benefit from 3D support. We will collaborate on a workflow for secure handling and scanning on any ASC artifacts to be scanned, and think about how future ASC processing workflows might include capturing 3D digital model files of artifacts.

Budget
Research into appropriate equipment included speaking with humanists doing archaeological and archival 3D work at ▓▓▓▓ (institutions) ▓▓▓▓. We're attempting to strike a balance between the cheapest options (assuming in the short run we'd need to upgrade to intermediate options, costing more total) and highest grade options (e.g. the $25k Artec Spider might one day be useful, but I'd want several years of prior 3D work, successful class and research use, and external funding for an investment that large). **Total requested: $7596.98.**

3D Scanner (museum-quality, portable; creates digital model files from physical objects)	Choice: NextEngine 3D Scanner **$2995** (no size limit for scanning) and MultiDrive **$995** *Compare to:* ● Artec Spider $25,000 ● Fuel 3D Scanify $1490.00 ● MakerBot Digitizer $799
3D Printer (creates physical models from digital files)	Choice: Ultimaker 2+ Extended **$2999.00** *Compare to:* ● PrintrBot $1199.00 ● MakerBot Replicator 2X $2499 ● FormLabs Form 2 $3499
Filament (the material the 3D printer prints with). Various materials, colors; enough for two years of comfortable experimentation.	Glow $59.99, wood $54.99, bronze $65 2 x flexible = $50, carbon $75, 3 x ABS = $102, 3 x PLA = $117, higher-end PLA $34 (13 total spools, **total $557.98**)
Software for working with digital files after scanning and/or before printing. Commercial software will allow initial experiments to focus on hardware calibration; after	Fuel 3D intermediate software ($50.00 for one year subscription) *Compare to:*

a year, I'd shift to using free, open-source software from [the options listed by the Engineering Library]().	● PrintrBot (free commercial software for one year with printer) ● MakerWare for Digitizer included with MakerBot Digitizer
Large working table (to hold printer)	Request Aux Services check in attic
Total requested	**$7596.98**

Future possible costs that will be supported from DH Specialist startup funding and other sources: protected cart for bringing artifacts from ASC; blue painter's tape for printing bed improvement, sink for cleanup; ventilation/fan; table covering; dedicated computer, monitor, keyboard, mouse, cables; lockable space for storage; shared ASC+DH graduate research assistant to assist with project design, 3D work, training others.

<u>Why not use the Engineering Library 3D setup?</u>
The Libraries already supports a 3D *printing* setup in the Engineering Library, but for various reasons this is not adequate for digital humanities *scanning, modeling, and printing* work:
1. Most of our research focus with the dedicated 3D setup will revolve around calibrating and customizing the setup to create accurate, representative facsimiles of historical artifacts, which requires DH and ASC experts to have hands-on oversight of the process. 3D printing setup in the Engineering Library is designed as a *service* producing finished print-outs to those who submit files, rather than letting you calibrate settings and experiment to make the most representative facsimile for your given research use.
2. DH research use necessitates iterative experimentation; the listed wait time for a print from the Engineering Library setup is up to a week.
3. Transporting rare and fragile artifacts safely and securely from the ASC is simplified by keeping the equipment in-building. Future ASC processing workflows might include capturing 3D digital model files of artifacts.
4. This expertise will allow experimentation focused toward publishing best practices for *humanities* research, without competition from other (e.g. STEM) uses of existing equipment and without needing to constantly recalibrate from others using the equipment.

<u>Examples of possible projects</u>
Ideas that could be developed into full lesson plans, courses, or collaborative DH projects seeking external funding.

● **General classroom use.** The 3D setup will allow students to have a dedicated space to explore digital interactions with the objects in ASC's rich collections, where humanities students and faculty could experiment directly with the machines while getting archivists' support in handling items and negotiating file/image reuse/sharing/copyright.
  ○ A classroom module would be designed around scanning some of the more interestingly structured Flight/Space Archive artifacts, such as Neil Armstrong's model of a lunar landing module. Students would then be able to access, extend, and handle these artifacts extensively without damaging the original artifact and with options such as printing magnified versions of an object to better assess its texture and structure.
  ○ ___(A specific professor's)___ course around writing historical material object analyses currently asks students to write about a speculative archival artifact; we could support students creating and printing these speculative artifacts, possibly by combining digital files of real artifacts into a chimera object.

- ○ Use 3D facial models for a direct connection with historical personages that would be otherwise difficult to gain, beginning with our John Purdue death mask.

  (possible research project idea)

- ● **How close can we get 3D models and printing to the originals?** Teaching archival concerns around authenticity, materiality, and representation (e.g. presentation differs depending on what significant property you're focusing on) through experimentation with equipment calibration, materials, and post-printing processes.
- ● **How can 3D scanning and modeling improve current archival processing workflows?** Augment existing digital collection items with 3D files; interactive 360+ degrees animations of artifacts; packaged lesson plans for K-16 including videos explaining archival artifacts, their details, differences in models, and possible discussion questions.
  - ○ Students "adopt" significant artifacts to explore multiple paths of documenting, describing, narrating, and the metadata and narratives they create are incorporated into the archive for future learners.
- ● **How can we meet the need for archival facsimiles?** Meet the need for exhibits around Purdue and ASC history for external institutions (e.g. recent Indianapolis Symphony exhibit), the West/Lafayette community, and Purdue's 2019 dual 50th moon landing / 150th Purdue founding anniversaries. Create facsimiles for hand-outs at Libraries and Alumni events, to pique interest in humanities projects and ASC collections (e.g. wearable facsimiles of Amelia Earhart's flight goggles, possibly with add-on to hold smartphones a la Google Cardboard and display related Purdue history projects or apps).
- ● **Tangibility.** The ability to touch and manipulate objects and representations of data inspires the curiosity and questions of learners. Additionally, tangibility adds accessibility to visualizations, timelines, maps, and graphs for the visually challenged. Building on existing museum work allowing visitor access to facsimiles (e.g. the Art Institute of Chicago offers a range of sculptures with which visitors can feel the differences of various materials and compare the effects of erosion over time), we will attempt to make the learning and research outcomes of tangible access to artifacts more rigorous.
- ● **Improving active participation with research involving rare and fragile artifacts.** In addition to increasing access to artifacts, 3D scanning and printing would allow those without archival training to directly handle a fragile object like Neil Armstrong's model lunar lander module, experiencing first-hand detail, dimensions, and texture. But students could do much more than just touch these artifacts.
  - ○ Digital 3D versions of, for example, the lunar module model can be explored on a computer: magnified to better see details (the Smithsonian was actually able to read eroded engravings on old armor by scanning the armor and then manipulating the scan file on a computer), included in animated tutorials (historical airplane propellers and wind flow; orbit paths), labeled and cross-sectioned, and digitally manipulated (e.g. students could see what a statue missing a piece would look like in its complete state, or digital files for objects on which colors had faded or washed away could be colored again).
  - ○ These same activities could also happen with the printed-out plastic copy of an artifact.
- ● **Access to off-campus artifacts.** The purchased scanner will be reasonably mobile, so that scans of artifacts held off-campus (e.g. in museums in an astronaut's hometown) can be made when ASC staff visit them, then brought back to campus and printed so that a class can tangibly experience a remote artifact.
  - ○ Copies of these artifacts could be printed here on-demand when a class requires, and kept for future use by the teacher of that class (we could also provide storage to "check out"

already printed versions of artifacts, but we expect teachers will like having their own copy of a few key artifacts to use frequently in their own teaching).

- **Improving world access to Purdue's artifacts.** Purdue Libraries could host downloadable 3D image files of some of our ASC's artifacts; we'd begin by identifying 5 key objects that are some combination of highly interesting and difficult for non-archivists to access (rare, fragile, not well represented by photograph).

- (grant project idea)

- **Specific ASC collections or artifacts tagged for projects include:** a 3D tour of the ASC vault, pliable/wearable 3D print of the lunar glove, Earhart flight suit, historical planes/propellers, artists' books, Armstrong lunar lander module model. Anything that is fragile, rare, dangerous (lunar dust, jet fuel...) in the ASC—things that students or even researchers can't currently touch or see. Anything in the ASC that would benefit from a cross-section (even if the insides don't exist or can't be scanned, because these can be digitally modeled) or demonstration of them item in context and/or in use (historic propellers).