



Narrative Section and Design Document of a Successful Application

The attached document contains the grant narrative and design document of a previously funded grant application. It is not intended to serve as a model, but to give you a sense of how a successful application may be crafted. Every successful application is different, and each applicant is urged to prepare a proposal that reflects its unique project and aspirations. Prospective applicants should consult the Public Programs application guidelines at <http://www.neh.gov/grants/public/digital-projects-the-public> for instructions. Applicants are also strongly encouraged to consult with the NEH Division of Public Programs staff well before a grant deadline.

Note: The attachment only contains the grant narrative and design document, not the entire funded application. In addition, certain portions may have been redacted to protect the privacy interests of an individual and/or to protect confidential commercial and financial information and/or to protect copyrighted materials.

Project Title: Digital Giza: A New Portal to the Pyramids

Institution: President and Fellows of Harvard College

Project Director: Peter Der Manuelian

Grant Program: Digital Projects for the Public: Prototyping Grants

Digital Giza: A New Portal to the Pyramids**A) Nature of the request:**

The objective of this Digital Projects for the Public (DPP) Prototyping Grant is the creation of a scale-version prototype of the Giza Project's forthcoming public website—*Digital Giza: A Portal to the Pyramids* (*Digital Giza*, for short). Using the tools of the future to study the past, this public resource will integrate diverse, primary documentation from over 100 years of international archaeological research with the most archaeologically accurate 3D immersive computer model to date of the entire Giza Plateau, including the pyramids, temples, settlements, and surrounding cemeteries. The result will be a powerful new online education and research tool for the world community at all levels of expertise. After we cross-link the most comprehensive collection of Giza archival material in a powerful relational database that is structured specifically for site-oriented data, we will combine it with a sophisticated virtual online interface that is both educational and inviting. Fashioned on the concepts of heuristic, inquiry-based and free-choice learning, Digital Giza will provide users with access to rich archaeological data (photos, diaries, drawings, etc.) previously reserved only for scholars. Through varied formats of “digital archaeology experiences”—some narrative-driven and others free-form—visitors to the site will engage with new forms of interpretation and story-telling based on Giza materials digitally embedded and clearly contextualized in their original spatial settings within the 3D model. The Giza Project's ultimate deliverable will be disseminated in an online format that can reach the broadest possible audience: an interactive website and virtual environment encouraging exploration into Egyptological, historical, and more general humanities themes (see below, Section B).

The Giza Project, a collaborative international initiative based at Harvard University, has as its ultimate goals the comprehensive collection, electronic preservation, scholarly study, and public presentation of data on the world's most famous archaeological site: the Giza Pyramids of Egypt and their surrounding cemeteries and settlements (3rd millennium BCE to present). Building upon fifteen years of academic data processing and integration at Harvard University and the Museum of Fine Arts, Boston, the Project has now reached a maturity where exciting new forms of outreach and education are possible. We plan to provide unprecedented access to Giza in ways unavailable even at the physical site in Egypt today, through an innovative blend of traditional and new approaches to digital archaeology and data management. As gauged by research and granting trends of the last decade or so, the most recent era of archival and heritage activity has prioritized for two objectives: *preservation* and *access & democratization* of resources; that is, digitization of archival collections for long-term preservation, and making archival collections accessible to the many, not just a specialized few. Consistent with the Giza Project's mission and the current evolution of graphical/“virtual” visualizations of information, we believe that the next steps will require *using* and *crafting experiences* around this readily available and often voluminous material. Access is only one part of the equation, since often such sources are specialized in content and unwieldy in quantity. *Digital Giza: A New Portal to the Pyramids* is the Giza Project's solution for the other half of this equation, bringing together the two pursuits in which it has excelled—archaeological information management & dissemination and archaeologically accurate graphic visualization. We respectfully request a one-year, \$100,000 NEH Digital Projects for the Public Prototyping Grant to build on the achievements of past work and present one of the world's richest archaeological legacies to the global community. It is our belief that the compelling scope of this Project, covering nearly 5,000 years in the life of a world heritage site, with its great humanities and outreach potential, serves to qualify it for NEH support.

B) Humanities content:***Humanities Ideas, Themes, and Scholarship:***

In the current global environment, in which disparate societies and cultures are becoming ever more closely interlinked, it is critically important to foster knowledge of world history and the great civilizations of the past upon which numerous fundamental structures of modern life are built. An appreciation of the innovations, events, and peoples of the past that have contributed to shaping

contemporary society can help us understand the world in which we live and thus become better world citizens. Inspiring Americans to connect with history is a challenge that needs to be addressed in new and innovative ways. Ancient Egypt's widespread, nearly universal appeal makes it extremely well suited as a focus for humanities exploration and education. In fashioning a new kind of digital media asset for the global public, the Giza Project is dedicated to three significant humanities themes, which manifest themselves throughout our work:

1) Ancient Egyptian history, art, and society come alive when we explore how archaeology highlights Egypt's enduring contributions to world cultural heritage. We aim to bring ancient Egypt to life for the modern public, based on the rich legacy of Egyptian material culture at Giza. The ancient Egyptians are widely perceived as a people preoccupied with death. This modern conception results largely from the extensive resources the Egyptians devoted to preparation for death and expectations of an afterlife, combined with the disproportionately good preservation of mortuary sites as compared to the poor preservation of "living spaces" (dwellings, settlements, etc.). Surviving architecture, inscriptions, and artifacts from Giza provide tangible remnants of the ways of life (and sometimes even the names and biographies) of the ancient Egyptians, allowing modern audiences to understand that they share many of the same dreams, goals, and fears with their ancient forebears. A more thorough and nuanced consideration of these primary sources (monuments, texts, objects) reveals that, even within the country's most famous cemetery (Giza), the ancient Egyptians produced a vibrant, accomplished, and ultimately life-affirming culture whose heritage is still a source of fascination, relevance, and debate today.

2) How can we engage effectively with the past? Today, digital archaeology provides an important path to enriching our interpretation of ancient Egypt, or indeed any early civilization. We plan to highlight the benefits of digital archaeology as a new learning forum, not solely for scholars, but for the participation of everyone equipped with a web browser and an interest in ancient peoples, history, or human heritage in general. Archaeology and the writing of ancient history are inherently reconstructive processes, usually from incomplete records. An interactive approach to digital archaeology opens access for all to primary documentary materials as well as the process of historical/archaeological reconstruction. Engaging with the distant past allows the modern user to learn about shared aspects of the human condition, and reveal the relevance of history to the current world. Through both cutting-edge and well-established technologies of visualization, experiential learning (providing the user with choices in a virtual environment), and information management, we aim to provide all those who have curiosity and internet access with the tools and guidance to venture down their own paths of historical exploration, regardless of interest level or background knowledge. We hope to instill an appreciation for not only ancient (Egyptian) culture specifically, but also more broadly for the very practice of historical investigation itself.

3) Combining the traditional study of Egypt's past with digital archaeology preserves and presents its cultural heritage for future generations. Giza represents a powerful expression of the ancient Egyptians' quest for immortality. Their cultural memory is embodied in tombs, temples, texts, scenes, and artifacts, all intended to survive long past the death of the individual. Today, we pursue the preservation, interpretation, and transmission of ancient Egyptian culture and wisdom for the enrichment of generations to come. Giza is thus not merely the remnant of a particular point in history, but a complex testament to how both ancient and modern societies confront two of the most fundamental, existential questions about the human condition: What is our "place" in the world, as individuals and collectives? And what happens when we die – what are our expectations, for our own legacies as individuals and for the society we leave behind?

The ancient media the Egyptians used often consisted of limestone and hieroglyphs. By converting these material manifestations to electronic form for the modern era and creating unprecedented global access, we hope to fulfill the essential task of heritage preservation and dissemination. Our audience will learn, not just about how the ancient Egyptians died, but about how they lived and, more importantly, what they valued and how they wished to be remembered.

We believe the multi-channeled approach of Digital Giza will provide a model for archaeological information presentation and management, applicable beyond Giza, beyond Egypt, to any number of sites

and eras around the world. In this sense, the Giza humanities themes are also universal themes that can speak—via primary evidence made accessible by the Giza Project—to concepts of nostalgia, revivals and uses of the past, including nationalist and Afrocentrist approaches to ancient Egyptian culture. Many of these fields have yet to be explored via such new information pathways.

Comparable Projects:

There are currently numerous Egyptological websites that include photo documentation, plans, and bibliography on individual tombs and monuments, such as Osiris Net (<http://www.osirisnet.net/>) or the Theban Mapping Project (<http://www.thebanmappingproject.com/>), and databases that enable users to explore archaeological and/or art historical materials as sorted by a range of search parameters, such as Oxford's Egyptian Scene-details Database (http://archaeologydataservice.ac.uk/archives/view/oe_ahrc_2006/). Other projects have created websites to publicize their research on individual ancient Egyptian sites. The websites of Leiden University's expedition to Saqqara (<http://www.saqqara.nl>) and the University of Cambridge excavation at Amarna (<http://www.amarnaproject.com/>) contain much useful information on current work at these sites; similarly, the Ancient Egyptian Research Associates (AERA) website (<http://www.aeraweb.org/>) contains data from active research and excavation carried out at part of the Giza Plateau. Like the Giza Project, these are site-specific projects whose websites make available photographs, descriptions, maps, and site reports to an online audience. However, they tend to be much narrower in scope: mainly devices for communicating progress and fund-raising. They are neither interactive nor dynamically searchable by the user, and usually only cover in detail the area(s) of the sites that are currently under investigation, providing little access to primary data or publications from previous or concurrent excavations by other institutions.

A few other Egyptological projects have focused on constructing 3D virtual models of individual ancient monuments and/or artifacts, such as the Polish Jagiellonian University archaeological mission's Tell el-Farkha site reconstructions (<http://scienceinpoland.pap.pl/en/news/news,403626,poles-reconstructed-houses-of-the-first-egyptians.html> and <http://scienceinpoland.pap.pl/en/news/news,396547,one-of-the-worlds-oldest-breweries-reconstructed.html>), the great temple complex of Karnak by UCLA's Digital Karnak (<http://dlib.etc.ucla.edu/projects/Karnak/>), or some houses at the Manchester Museum's Virtual Kahun (<http://www.museum.manchester.ac.uk/collection/ancientegypt/virtualkahun/gallery/>). Though these sites have generated some interesting experimental digital work (for one recent example using the Digital Karnak model, see <http://www.britishmuseum.org/PDF/Sullivan.pdf>), they generally lack connections to data, archival information, and previous scholarship that add meaning and context for the models, as well as transparency in explaining the choices their creators have made in the modeling process. The AMARNA: 3D Project (<http://www.amarna3d.com/>) contains some useful functionalities (such as a Google Streetview-style navigational tool that will be incorporated into the new Giza site as well), but does not contain any of the actual excavation data on which the 3D model was based. The original data is a verification source that is important for specialists and amateurs alike.

The ultimate vision for the Giza Project at Harvard University includes facets of all of these projects and more. Digital Giza aims to facilitate widespread access to both archival and current data by allowing users to approach them in multiple ways according to their particular interests and inclinations, including the exploration of archaeologically accurate 3D models on both a micro (single artifacts, individual tombs) and macro (Plateau overview site model, incorporating GIS and digital elevation models) scale. All of these approaches will be intelligently and dynamically linked to a fully searchable dataset of unparalleled breadth and depth. Some projects digitize archival material; others recreate ancient monuments in computer renderings. The Giza Project is one of extremely few to blend both approaches for comprehensive access to the site and its artifacts from almost any starting point of inquiry—visual or textual, amateur or expert. Guided narrative pathways called “Gateways to Giza” will introduce this treasure trove of data to novice users while providing them with the tools to follow their own interests and explore further on their own.

Resources:

The most important resources of the Giza Project are the massive and comprehensive digitized archival data holdings currently housed in the Project’s GizaCARD (Consolidated Archaeological Reference Database), an NEH-funded endeavor (ID number PW-51569-14) that forms the underpinnings of the new website. We have assembled electronic archival datasets through collaborative agreements around the globe, focusing mainly (but not exclusively) on collections from fifteen international institutions in nine cities: the Hearst Museum of Anthropology, Berkeley, CA; the Museum of Fine Arts, Boston; the Ägyptisches Museum & Berlin-Brandenburgische Akademie der Wissenschaften, Berlin; the Egyptian Museum & (forthcoming) Grand Egyptian Museum, Cairo; the Peabody Museum of Archaeology and Ethnology, Harvard University; the Roemer- und Pelizaeus-Museum & Stadtarchiv, Hildesheim; the Ägyptisches Museum, Universität Leipzig; the University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia; the Museo Egizio & Ministero per i Beni e le Attività Culturali, Turin; and the Kunsthistorisches Museum & Ägyptologisches Institut der Universität, both in Vienna. Their pooled data at Harvard collectively represent the largest self-contained collection of Giza archival and documented artifactual materials ever compiled, all in electronic form. Through consolidation and standardized processing by the Giza Project this substantial volume of scattered records will become publicly available, not merely as discrete collections—as physical archives are, inherently—but as a vastly larger, complex array of interrelated information that reflects Giza’s overall significance.

From the collaborating institutions listed above, the Giza Project holds in its database photographs (showing field excavations, old and recent site shots, artifacts, and museum gallery and storage views), field diaries, object/photo register books, architectural and site plans, facsimile line drawings, researcher notes, correspondence and un/published manuscripts, as well as other types of documents. They total approximately 170,000 files, occupying 1 TB of storage space. In anticipation of the continued mainstreaming of 3D-modeling and printing, a future phase of database expansion is planned to integrate three-dimensional modeling assets generated by the Project’s digital artists. Thereafter, public crowd sourcing of new models will also be explored. Currently the Giza Project’s 3D modeling assets total approximately 300 primary models and an additional 1,500 derivatives, as well as approximately 2,000 supplementary (2D) files used in modeling processes and output, accounting for an additional 1.2 TB of stored files. These files combine to allow not only real-time navigation across the entire Giza Plateau, but also immersive first-person exploration of interiors and exteriors of the following major Giza monuments: Khufu Pyramid Complex, Khufu Pyramid Temple, Khufu Valley Temple, Khafre Pyramid Complex, Khafre Pyramid Temple, Khafre Valley Temple, the Sphinx, Sphinx Temple, Menkaure Pyramid Complex, Menkaure Pyramid Temple, Menkaure Valley Temple, Menkaure Valley Temple Settlement, Tomb of Queen Hetepheres, Mastaba Tomb of Queen Meresankh III, 3-Tomb Family Complex G 2100, Mastaba Tomb of Nefer, Mastaba Tomb of Kaninisut, Mastaba Tombs of Qar and Idu, and Harvard Camp (i.e., twentieth-century archaeological expedition headquarters).

C) Project format:

Digital Giza will be a powerful web-based tool that will place the entirety of the Giza Project’s holdings within easy reach of anyone with an Internet connection. The website is conceived and designed to serve as an engaging educational resource and research apparatus for as wide a public audience as possible, ranging from age 12 to senior citizen. By adopting this outlook, we take on the unique challenge of creating an asset that can function effectively as “all things to all people” within these broad parameters. Given the vast quantity of information that will be accessible through Digital Giza, there is a potential for “data overload” for casual users. Anticipating this, the project will design a simple, front-facing interface with specially conceived access points, or “Portals” from Digital Giza’s homepage connected to multiple clearly-defined paths to support non specialists as they ease into the extensive content. The five Portals are (see Design Document for more detail):

- **INTRODUCTION TO GIZA:** Ancient Giza and its archaeology in historical context

- **GATEWAYS TO GIZA:** Video vignettes produced from 3D Giza models with embedded interactive features, including user-generated choices of topical concentration and responsive, game-like content that incorporates diverse types of Giza data (both 2D and 3D). These will include first- and third-person narrative story-telling frames.
- **VIRTUAL GIZA:** User-driven, real-time navigation of the entire 3D Giza model environment as well as more detailed immersive exploration within Giza's major monuments, interspersed with content and cross-over connectivity to database holdings.
- **GIZA MAPS:** Spatial selection and searching of Giza monuments and areas of interest via a familiar interface reminiscent of Google Maps, including plan view, satellite/aerial view, and 3D top view.
- **SEARCH GIZA:** Simple and advanced searches of the Giza Consolidated Archaeological Reference Database (GizaCARD), which houses all available records and media held by the Giza Project, making it the most comprehensive Giza database in the world.

Conceptually these entry routes are differentiated by two main factors: expectations of user needs and nature of initial user interface. We stress “initial” user experience because, once past an entry Portal, users’ own activities will dictate crossover between different site sections via paths that gradually introduce more types and quantities of information. This multi-portal approach not only ensures that new users will have options for guiding them towards information and encounters that suit their interests, but also that return visitors may go immediately to the pathway or search options of their choosing. For instance, where an eighth-grade student may wish to enter into Virtual Giza to continue his or her explorations, a researcher may prefer to go directly to the extremely robust database search tools within Search Giza.

Other major facets of Digital Giza, accessed not via Portals but instead through persistent drop-down menus, include:

- The Digital Giza Library: a continually growing bibliography of freely downloadable, copyright-cleared searchable books and articles about Giza in PDF format, many of which are linked to database holdings and the Virtual Giza monuments discussed within their pages. We previously made 547 such publications available through our original, MFA-hosted Giza Archives Project website (www.gizapyramids.org); about 100 additional items are ready to be newly released as part of Digital Giza, and our preparation pipeline numbers over 100 more.
- Giza News and Blog: the “command center” for communications by which users will keep up with new additions/expansions of Giza content and functionality, as well as other items of general interest via regular blog posts and our social media presence (e.g. Facebook, Twitter, Pinterest). They will have the added ability to post any Digital Giza media (except “live” 3D models) to their own social networking accounts via embedded posting functions included on every data record page.
- My Giza: users who create a (free) login profile will be able to save all types of Giza data in personalized “My Giza Collections,” which will aid in organizing research materials and can be shared with friends, colleagues, and classmates via social media sites.
- Educational Resources: links to other carefully vetted sites with educational content on Giza—e.g., EDSITEment (<http://edsitement.neh.gov/>); the British Museum Ancient Egypt Page (<http://www.ancientegypt.co.uk/menu.html>); and eventually EdX/HarvardX online courses (<http://www.edx.org/>; <http://harvardx.harvard.edu/modules-and-courses>).

A public website format enables the Giza Project to provide free access to its vast holdings on a worldwide scale. A web-based approach permits the construction of multiple, intersecting paths to accommodate the variety of user needs that such a large public audience demands. The structure of Digital Giza (see Section 7, figure 1, Site Map; and Section 8, Design Document) is based on notions of heuristic and self-guided, inquiry-based learning about ancient Egypt, rather than linear, didactic

instruction. The access Portals described above will guide different types of users into Digital Giza in such a way that, no matter the sequence of clicks, they will encounter archaeological information in a manner that is, essentially, “*doing* digital archaeology,” that is, exploring the site onscreen instead of standing in an excavation pit. Some users will come to Digital Giza with questions, embarking on their journey via a simple search; others will be guided through narrative “Gateways to Giza” to explore what interests them. Some will branch from our simple Introduction to Giza material to data records that springboard them onwards to further inquiry; and still others will find themselves captivated by the ability to sift through pictures and diaries of excavations of the very room in which they are standing within Virtual Giza. Through their exposure to all these diverse Giza data types and media, Digital Giza users will explore the many ways that the past, present, and future of ancient Egyptian heritage are connected.

Every path through the Digital Giza website will expose visitors to as many types of media resources and encounters as possible. Additionally, the ability to post annotated material directly to social media and educational outlets supports reflection and analysis, giving all users the ability to amplify their own engagement with history.

D) Audience and distribution:

Digital Giza will make available numerous customizable and self-defined paths for exploration of the entire Giza necropolis. Providing access at all different levels of interest and knowledge to a wide-ranging audience of users is our grand vision and long-term focus. **For the general public**, the virtual 3D model will provide views of the entire Giza Plateau in a new experiential environment. The guided “Gateways to Giza” will contain overviews of some of the humanities themes addressed within the archaeology and history of Giza. Users will even be able to view the site from positions no human could physically attain: for instance, from underground, allowing for visualization of the relative positions and sizes (and thus social hierarchies) of countless burial shafts extending beneath the individual tombs. It will also offer access to portions of the site that are closed to visitors, reburied, deteriorated since excavation, or otherwise inaccessible. “Edu-tourism” takes on entirely new possibilities with this merging of old data and new immersive navigation technology. The results hold value for everyone: those who have visited Giza, those who anticipate doing so, and those who will never have the chance to see the site in person.

The Digital Giza website will facilitate the efforts of K-16 **teachers and students**. We will reach out to editors of middle-school magazines such as Dig and Muse published by Cricketmedia; to involve teachers we will disseminate to the National Council for the Social Studies (<http://www.socialstudies.org>) and the Massachusetts Council for the Social Studies (<http://www.masscouncil.org>). On the new website itself, individual “Spotlight Giza” object and media highlights and periodic blog entries will feature various Giza-related topics to stimulate class discussion. Gateways to Giza will make excellent starting points for class exploration into some of the larger questions about ancient Egyptian culture and history, and how they are studied and interpreted today. Descriptive Egyptological thesaurus terminology will allow students and other users to search through tens of thousands of modern and archival photographs in order to identify and collect different types of content across hundreds of tombs bearing important wall paintings and reliefs (historical events, craftsmanship, ritual, gender-based activities, flora and fauna, pose and costume, hieroglyphic inscription genres, etc.). Constituent records will contain information on ancient Egyptians as well as modern-era individuals connected to Giza, along with all their associated data.

Users who create a (free) login profile will be able to save all types of data in their own “My Giza” study collections that may be shared with classmates and friends. The ability to group and save publications, objects, images, and other types of documents according to individual interests and applications will allow teachers to create customized lessons and design assignments, while enabling students to gather materials for reports and presentations. Starter “My Giza” collections will be available to complement other sources and act as additional points of departure. Their assembly will be based on broad general interest topics, such as Experiencing the Past (e.g., Daily Life, Growing Up at Giza, Ancient Egyptian Religion, Environmental Impacts, Ancient Families, Crafts & Professions); Museums

& Collections (Collection-building through History, Heritage and Repatriation); Photographic Perspectives (Early Photography, Modern Life on the Nile, Aerial Photography, Excavators in Egypt); etc. Additionally, links to the NEH EDSITEment site will convey related educational content along with recommended sequences for introducing material common to various grade levels.

In the course of their exploration, **scholars** must often collect all the disparate materials available for a given object or archaeological feature. To take one example, for an ancient statue the website will provide original discovery in-situ photos, modern color studio imagery (from the institution that currently houses the statue), diary entries describing its discovery, architectural plans of the findspot and archaeological context, as well as both published and unpublished secondary literature, even though all these archival data may be physically housed in separate institutions on different continents!

Optimal worldwide availability and long-term sustainability are core objectives of the Giza Project's work. Dissemination of the deliverables produced during the grant period will take several forms, as we focus on reaching audiences from primary and secondary school students to professional Egyptologists and all interested parties in between. For the new Giza website, the addition of embedded social networking functionality will be a significant, consistent driver of traffic and first-time visitors. The Giza Project aims to harness the powerful influences of online social media (e.g. Facebook, Google+, Twitter, Pinterest, etc.) to disseminate information "virally" to audiences more widely than possible through a single online venue, and to take advantage of their potential for generating site awareness and traffic. Media files accessed via the Giza site will be accompanied by social networking icons through which users can post them directly to their accounts on relevant social websites, organically opening countless new outlets for appreciation of the project's holdings.

Ultimately, we foresee Digital Giza being made available through one or more mobile apps as well as immersive interface devices, such as home-use virtual reality headsets. In the future we intend to explore augmented reality solutions, so that visitors to Giza can point their smart devices' cameras at a hill of sand or debris and see the original excavation and discovery photos for that space and the artifacts it once revealed, complemented by a 3D reconstruction of those archaeological remains. For online and home use, the media team remains current with available peripheral hardware in order to extend fully immersive capabilities to the widest possible user base. The most recent progress has been to view and test the Giza model using the Oculus Rift (www.oculusvr.com) and Samsung Gear VR (www.samsung.com/global/microsite/gearvr) 3D virtual reality headsets, relatively low-cost but powerful immersive interface devices.

We expect to "loan" our Giza 3D content to a wide range of special museum exhibitions with themes such as archaeology, pyramids, ancient technology, 3D modeling, cultural patrimony/repatriation, etc. Our graphic content has already appeared in exhibits at the Oriental Institute Museum of the University of Chicago, the Roemer- und Pelizaeus-Museum, Hildesheim, the Kunsthistorisches Museum, Vienna, and the Semitic Museum at Harvard University. We hope it will eventually be on view in the new Grand Egyptian Museum, to be located just north of the Giza Plateau, scheduled to open in the next several years. These exhibits will provide broad exposure of our work to the museum-going public at venues all around the world. Closer to home, the content will feed into the PI's regular Egyptology classes, and in semester-long courses and smaller educational "modules" in HarvardX and EdX, the new online teaching initiatives currently under development (www.edx.org) by a growing consortium of universities. These online courses have the potential to reach tens of thousands of students at a time.

Edu-tourism is also a powerful dissemination tool. For those planning travel to Egypt, the future Giza website will provide an exemplary introductory orientation, even allowing digital access to parts of the site that are not routinely open to tourists. The political instability and security troubles that have gripped Egypt since the January 2011 revolution, and which have led to widespread looting and destruction of archaeological sites, museums, and storage facilities throughout the country, serve to highlight the current critical importance of the Giza Project's work. The irreplaceable data consolidated in our archaeological archives and made available to the global public on our website constitute a form of digital preservation in a tumultuous period when physical, "on the ground" conservation and visitation of monuments may not always be possible.

The Giza Project also continues to participate in the wider Egyptological and academic communities. The PI has a forthcoming book on “Digital Giza” with Harvard University Press (Metalab Projects Series), a historical description of the entire Project from its inception in 2000 to the present, as an example of a groundbreaking Digital Humanities initiative. The PI and Giza staff will continue to contribute scholarly articles based on Giza Project research to Egyptological publications, and popular articles to Egyptian archaeology-themed magazines with wide readerships such as KMT (US), Egyptian Archaeology (UK), Ancient Egypt (UK), Dossiers d’Archéologie (France), and Sokar (Germany). We will share links with all the major Egyptological blogs and websites. Finally, we will also present our results in both popular lectures and scholarly conferences, among them the national and local meetings of the American Research Center in Egypt, the annual meeting of the American Schools of Oriental Research, and the International Congress of Egyptologists, as well as at technology conferences such as South by Southwest (SXSW) and the Digital Heritage International Congress in Marseille (where the PI presented a Giza Project keynote speech in late October 2013). In addition to numerous lectures and discussions at Harvard and in the greater Boston area, the NEH has asked the PI to speak about the Project’s progress at the upcoming annual meeting of the Archaeological Institute of America (Jan. 6-9, 2016 in San Francisco).

E) Project evaluation and testing:

This project includes two evaluation phases, one formative phase at the outset of the grant period and one to test the prototype as it nears completion. For both we will collaborate with staff of the Harvard Museums of Science & Culture (HMSC). For their regular slate of exhibition, educational, and online activities HMSC’s interpretive and educational staffs test approaches for presenting collections and concepts to diverse public audiences. HMSC relies heavily on focus group feedback to productive ends, with members drawn widely from the museum-going public who have a tradition of responding enthusiastically to calls to assist. *Formative Phase:* The project will engage focus groups of teachers, sixth graders, and interested adult non specialists to identify question types most frequently posed about website content. Focus group members will be recruited from HMSC’s network of members (900), visitors (250,000), and school group visitors (42,000). We will take special note of searching trends to identify questions that we had not previously considered as we build the Digital Giza prototype. This research will guide our construction of the Digital Giza website layout.

A one-month *Test Phase* is scheduled for October 2016 and will use a combination of individual observation, interviews, and back-end analytics techniques to test our website. We will call upon the HMSC’s public network once again for recruitment. In addition to other venues, we anticipate tying a testing event to Harvard’s annual Amazing Archaeology Day 2016. This event takes place across two venues on the Harvard campus in conjunction with Archaeology Month for the Commonwealth of Massachusetts, drawing an average of 500–600 attendees. Walk-in participants will be invited to access Digital Giza, and to provide their impressions of usability. Refined user questions will be piloted in order to revise the pathways developed for portals. We will post Google analytics code to track back-end metrics about most/least used/revisited sections of the site. To expand the range of participants, and to continue the collection of site use metrics through the months of October–November, one or more walk-in stations will be made available in the Harvard Semitic Museum, the HMSC institution that is most closely aligned with the Giza Project. Use by university students will also be evaluated, with testers drawn from the PI’s undergraduate, graduate, and Harvard Extension School classes, plus students from classes at as many other local and national universities as possible.

These varied audiences will bring differing perspectives and interests as well as levels of expertise and knowledge, allowing Giza Project staff to make further adjustments and enhancements so as to increase the website’s impact and outreach. Revision based on feedback will proceed through the end of the grant period in December 2016, along with any necessary troubleshooting and debugging. Submission and revisions to the Harvard Internal Review Board for the protection of human subjects will also be made throughout the testing process wherever appropriate.

F) Rights, permissions, and licensing:

The Giza Project is primarily based on the archaeological legacy of expeditions from the first half of the 20th century. The site of Giza was divided into three main concession areas, awarded to American, German, and Italian missions. In subsequent years, the American mission took over the Italian concession and the German expedition expanded under German–Austrian sponsorship. Later, an Egyptian mission joined the others. Our processing work involves the results of all of these expeditions, as well as several additional smaller ones. All expeditions divided their finds between their sponsoring institution(s) and the Egyptian Museum, Cairo. American-excavated tomb materials and documentation reside in Berkeley, Boston, Cambridge, and Philadelphia; German/Austrian materials are in Berlin, Hildesheim, Leipzig, and Vienna. Italian materials are in Turin.

The original excavation archival data from the Harvard University–Boston Museum of Fine Arts Expedition was slated as per a 1905 agreement to come to Harvard, along with the rights of publication. In actuality, the archive landed primarily at the Museum of Fine Arts, Boston, in 1947. From 2000 to 2011, most of the Giza material was digitized and processed for inclusion in the Giza Archives Project website (www.gizapyramids.org). Harvard and the Museum of Fine Arts, Boston, are moving forward with a signed collaboration agreement (attached), providing free access to the Giza data housed at the MFA. The Giza Project’s other national and international partners have also signed collaboration agreements with the Project, granting permission to process and make publicly available their Giza data, which have already been received in electronic format and incorporated into the Project’s GizaCARD database. All copyrights remain with these original institutions (for their signed collaboration agreements, see section 4). Therefore, we do not anticipate any significant permissions problems or licensing fees.

G) Humanities advisers:

Made up of Egyptologists and archaeological technical specialists, the Giza staff members have the academic backgrounds to determine the organizational structure for the work, the academic content of the data, and which features to emphasize online for different audience levels. For critical assessment and suggestions for our deliverables, we will turn to an external humanities advisory board.

Project Management, Content, and Outreach

Principal Investigator: **Peter Der Manuelian**, Philip J. King Professor of Egyptology and Giza Project Director, Harvard University. Role: Supervisor of all aspects of the Project; decisions on Egyptological data organization; overall website design and implementation; relations with international Giza partners in Egypt and Europe; responsible for hiring and managing Project Egyptology/technology part-time staff, supervising university students, and fundraising. Project continuity directing the work since its inception in 2000 at the Museum of Fine Arts, Boston.

Project Research Associate: **Nicholas Picardo**, Ph.D. candidate in Egyptology (University of Pennsylvania), Archaeologist. Role: TMS Giza data entry and integrity, verifications and corrections; concordance work on Harvard–MFA Expedition materials and European Giza collections; Giza website design; supervision of students and volunteers. Academic and archival research for processing international archival records and 3D model construction. Continuity expertise with the Project since 2009.

Project Research Associate: **Rachel Aronin**, Ph.D. candidate in Egyptology (University of Pennsylvania), Art Historian. Role: TMS Giza data entry and integrity, verifications and corrections; concordance work on Harvard–MFA Expedition materials and European Giza collections; Giza website design; supervision of students and volunteers. Academic and archival research for processing international archival records and 3D model construction. Continuity expertise with the Project since 2008.

Project Research Assistant: **Jeremy Kisala**, BA in Egyptology (University of Chicago). Role: TMS Giza data entry and integrity; supervision of Giza Digital Library PDF processing workflow; supervision of students and volunteers. Continuity expertise with the Project since 2006.

Humanities Advisory Board

W. Judson Harward, Director of Arts and Humanities Research Computing, Harvard University Information Technology. With a background in archaeology, digital humanities and the MIT iLabs prior to coming to Harvard, Mr. Harward is uniquely positioned to assess the role of our project within the academic community and beyond. We will look to him for guidance on how well we are reaching our respective audiences and insight into strategies for doing so.

Jim Waldo, Gordon McKay Professor of the Practice of Computer Science, and Chief Technology Officer, Harvard University (<http://www.eecs.harvard.edu/~waldo/>). As the University's Chief Technology Officer, Mr. Waldo will comment on the backend infrastructure of our website. Lest he sound overly focused solely on technological matters, it is worth noting that he has a humanities background (MA in Linguistics; PhD in Philosophy), prior to his work in the business and IT communities.

James P. Allen, Wilbour Professor of Egyptology, Department of Egyptology & Ancient Western Asian Studies, Brown University (<http://research.brown.edu/research/profile.php?id=1170774357>). As one of the most distinguished Egyptologists and president of the International Association of Egyptologists, Prof. Allen is superbly qualified to critique the scholarly applications of our work. His seminal work in Egyptian hieroglyphic grammar and Old Kingdom mortuary literature and religion put him in an excellent position to advise us on the organization of the Egyptological content on the Giza website and its effectiveness as an essential research tool.

John Baines, Professor of Egyptology; Fellow of The Queen's College, University of Oxford (<http://www.orinst.ox.ac.uk/staff/eanes/jbaines.html>). Prof. Baines is one of the foremost Egyptologists in the world and has written extensively on Egyptian visual and written culture. Managing the Online Egyptological Bibliography at Oxford, he has an unparalleled perspective on the organization of massive amounts of scholarly archival information. We expect his expertise to aid us greatly in modifications to Egyptological search functions, thesaurus terminology, and linking of the scholarly literature to our traditional archaeological data.

Florence Friedman, Visiting Scholar, Department of Egyptology & Ancient Western Asian Studies, Brown University, and Curator Emerita, Museum of Art, Rhode Island School of Design. Dr. Friedman has been studying the royal iconography at the Giza Necropolis for several years, in particular, the finds from the Menkaure Pyramid Complex, excavated by the HU-MFA Expedition. Her Giza expertise has been invaluable in helping us understand the original layout of the statuary program of Giza mortuary complexes. She will contribute her expertise on three-dimensional sculpture, iconography, and art historical features during the Old Kingdom in general.

Jeffrey Schnapp, Professor of Romance Languages and Literature, Graduate School of Design, Harvard University; Director of the Berkman Center for Internet and Society, and Director of Metalab (<http://metalab.harvard.edu>, <http://cyber.law.harvard.edu/people/jschnapp>). Prof. Schnapp is a cultural historian with research interests extending from Roman antiquity to the present. He came to Harvard from Stanford, where he directed the Stanford Humanities Lab. Now directing Harvard's Metalab, he oversees and supports a number of innovative digital initiatives that are making serious contributions to humanities scholarship and research. He will guide us in the look and feel of our website, and suggest new and creative ways to cross-reference our data and keep pace with developing trends in online academia.

Gabriel Pizzorno, Lecturer on History, Harvard University. Dr. Pizzorno has many years of digital humanities and archaeological engagement with the Digital Gordion Project in Central Turkey (<http://sites.museum.upenn.edu/gordion/>), focusing on one of the most important sites of the ancient Near East. He stands ready to contribute his archaeological and GIS expertise for the immersive layout and geographical organization of the data in context.

Janis Sacco, Director of Exhibitions, Harvard Museums of Science & Culture. As exhibitions director and senior developer/writer for the Harvard Museums of Science & Culture, Ms. Sacco has 28 years of experience crafting interpretive narratives for exhibit graphics, videos, and interactive media. She

also routinely supervises evaluations of exhibit products to improve their efficacy for public audiences. She will assist us with our focus groups and the overall assessment of our educational strategies.

Polly Hubbard, Education Program Manager, Peabody Museum of Archaeology & Ethnology, Harvard University. Ms. Hubbard's time as a middle school teacher helped her partner with the Cambridge public school district to develop a social studies unit linking classrooms with Harvard's Peabody Museum of Archaeology and Ethnology. She has assessed the learning potential of technologies for students over ten years of educational evaluations at the nonprofit research and development firm TERC. She will assist with all our focus group assessments, at the beginning and end of the grant year.

H) Production team:

Rus Gant, Giza Lead Technical Artist. Role: Combines archaeology, technology, graphic design, outreach, and 3D virtual reality skills; supervises 3D model creation of selected Giza tombs and other structures; oversees production of online videos; supports conversion of Giza virtual reality work and other technologies conducive to research and teaching. Continuity expertise with the Project since 2009.

David Hopkins, Giza Technical Artist. Role: Creates Giza 3D tomb models of selected tombs with a variety of software tools; supports conversion of 3D model files to Harvard Visualization Center for teaching and research; providing guidance on new website design and layout. Continuity expertise with the Project since 2011.

Rashmi Singhal, Software engineer, HarvardX, Harvard University: Back-end website scripting for new Giza website (with data supplied from TMS GizaCARD database). NB: The active, real-time querying of extensive, customized data tables from within an immersive 3D model environment is a significant and novel element of the website that requires advanced coding expertise. This complex level of cross-linking between these 2D/3D data and object structures, plus the need for clear and elegant design of multiple interfaces and search processes, collectively account for the relatively high web development budget line. Ms. Singhal will assist with creating JSON APIs to link the back-end SQL database (TMS) to the forthcoming public Giza website.

Jeff Steward, Director of Digital Infrastructure and Emerging Technology, Harvard University Art Museums. Mr. Steward has a great deal of personal involvement with the Giza Project, first at the Museum of Fine Arts, Boston, where he created many of the Project's plugins and enhancements for its original TMS database, and more recently at Harvard, where he has followed the Project's progress with great interest. Like Rashmi Singhal (above), he will advise on the creation of JSON APIs to link the back-end SQL database (TMS) to the forthcoming public Giza website. He was also part of the team at Harvard that created Mirador, the new open-source, web-based, multi-window image viewing platform that we hope to incorporate into the website.

I) State of the project:

The Giza Project has a proven track record of more than a decade of archaeological data processing, modeling, and presentation, producing innovative, award-winning web resources and popular Harvard undergraduate and graduate courses. The Principal Investigator of the current proposal initiated the work in 2000 as an employee at the Museum of Fine Arts, Boston, with the support of the Andrew W. Mellon Foundation. The primary goal of the MFA's "Giza Archives Project" was to provide global *scholarly* access to the Giza data from the Harvard University–Boston Museum of Fine Arts Expedition to Egypt (active from 1903 to 1947). We scanned, transcribed, and created database records for 37,199 Giza images (21,000 original expedition glass plate negative images plus 16,199 more recent images), 3,105 pages of excavation diaries, and 2,380 pages of object register discovery logbooks, resulting in 22,076 individual object records. Moving beyond this original mandate, we then added 10,000 digitized archaeological line drawings, 5,351 pages of unpublished manuscripts, and almost 1,300 Quicktime Virtual Reality (360-degree rotatable) panoramas taken at Giza. We also created a free online Giza Digital Library of scholarly and more popular publications in PDF format (posted with authors' permission and/or in accordance with fair usage guidelines, and all processed with optical character recognition for

complete searchability). The library has proven to be such a popular feature that we are continuing to expand its holdings and will make them available on the new Giza website as well.

The first Giza website was launched in 2005 (<http://www.gizapyramids.org>). A series of succeeding Mellon grants supported the Project over ten years (2000–2011), and 475 individuals contributed to the work: Egyptological staff, undergraduate and graduate students, museum docents and volunteers. From November 2011 to November 2012, the Giza website posted 38,558 visits from 25,079 people from 140 countries (data source: Google Analytics). There are currently more than 86,000 HU–MFA Expedition records on www.gizapyramids.org (see Section 7, Figure 25: website totals screenshot). The Society of American Archivists selected the Giza Archives website as the winner of the 2010 Philip M. Hamer and Elizabeth Hamer Kegan Award in recognition of its outstanding efforts in promoting the knowledge and use of collections (<http://www2.archivists.org/governance/handbook/section12-hamer>). The Giza Archives Project was also a 2011 Computerworld Honors Program laureate, in the Training and Education category (<http://www.eiseverywhere.com/ehome/CWHONORS2011/35791/?&>).

As a result of the information made available by the Project, the PI has published two scholarly monographs and numerous articles. For selected references and additional Giza publications by the PI, please see section 3: Bibliography. Countless other Egyptological excavation reports and masters and PhD dissertations have since relied on the Giza data on www.gizapyramids.org.

Beginning in 2009, the PI and the Project benefited from collaboration with the French 3D modeling software company, Dassault Systèmes (<http://www.3ds.com>), to begin building the Giza Necropolis in 3D (<http://giza.3ds.com>). Dassault Systèmes provided financial support from their “Passion for Innovation” program for Giza work in Boston. As a preliminary proof of concept and experimentation with interface capabilities, a 3D Giza website was launched in May 2012, combining a very small amount of the traditional Giza data, the navigable 3D model of the entire site with fourteen selected tombs and temples constructed in detail, short guided fly-throughs with the PI’s narrated voiceover, and other interactive features. This has allowed the Project to expand its public outreach greatly beyond the original Mellon Foundation mandate of providing an online research site primarily for scholars. Please see the 583-page, 60 MB PDF document containing hundreds of journalists’ worldwide press coverage in dozens of languages since the launch of <http://giza.3ds.com> in May 2012, available for download at <http://www.hightail.com/download/UW16TkF0OW5ubHIFQk1UQw>. More recently, Dassault Systèmes has ceased supporting the proprietary infrastructural components of Giza 3D’s modeling platform and of the Giza 3D website itself, causing the site to lose functionality and ultimately cease working. After that, the new Digital Giza website will be the only interface through which these sophisticated models, the most archaeologically accurate ever created, will be available. Additionally, present and future new reconstructions of Giza monuments will be integrated with the fullest repertoires of relevant data and archival records available anywhere. (See Design Document for our shift to non-proprietary, open source solutions for Digital Giza and associated sustainability strategies).

In 2014, the Giza Project was awarded a 2-year NEH Humanities Collections and Reference Resources (HCRR) grant for the creation and population of our core data management system, the Giza Consolidated Archaeological Reference Database (GizaCARD), a centralized relational database that is logically structured specifically for multiple types of site-oriented archaeological data (ID number PW-51569-14). Over the course of the grant period (2014–2016), Project staff members will continue to process and cross-reference thousands of digitized documents and media related to Giza’s archaeological record—currently housed in physical archives scattered around the world, from collections in North America, Europe, and Egypt. This substantial volume of disparate data is being consolidated in our database into a complex array of interrelated information reflecting Giza’s important material legacy in total. GizaCARD will in turn provide the data underpinning for all aspects of the new Giza Project website, the subject of the current DPP grant proposal.

With the scholastic research potential proven with www.gizapyramids.org and the 3D immersive and world outreach strategy firmly demonstrated with <http://giza.3ds.com>, we believe that all the key pieces are now in place to form the largest and most innovative publicly available Giza data resource ever

assembled. A major contribution to the widespread dissemination of this humanities knowledge base is the subject of the present NEH proposal: to create the website linking the two strategies described above.

J) Work plan:

The objective of the current proposal is to create a scale-version working prototype of the forthcoming Digital Giza website, combining the best aspects of both of our previous approaches (detailed below in section 8: Design Document). The following is a summary of past and future goals and objectives for the Giza Project. These goals have been divided into four stages:

Stage 1 (2000–2011) [pre-Giza Project at Harvard period]. The Giza Archives Project at the Museum of Fine Arts, Boston, collected and digitized all materials pertaining to the 40+ year-long HU–MFA Expedition to Giza, resulting in the creation of more than 80,000 TMS records. To provide access to the information in the database, the Project produced two free public resources: the scholarly research website <http://www.gizapyramids.org> and the pilot 3D website <http://giza.3ds.com>.

Stage 2 (2011–2016) [including NEH HCRR grant period (2014–2016)]. The Giza Project at Harvard is producing a completely integrated and fully linked TMS database (GizaCARD), incorporating the major collections of Giza objects and archival holdings across three continents, as well as periodically continuing to construct new 3D models.

Stage 3 (2016–2017) [NEH DPP Prototyping grant period]. The Giza Project will complete a prototype of the forthcoming new, fully integrated and searchable public Giza website, combining the archival “deep” data from all the individual global collections with an immersive 3D virtual model interface. This prototype site will demonstrate the full range of functionality for the 3D graphic models and data holdings for the Khafre Pyramid Complex (which includes the Khafre Pyramid, Pyramid Temple, Valley Temple, Sphinx, and Sphinx Temple). The result will be a scaled version of a unique tool for education and research, available for classroom use, scholarly research, edu-tourism, and social media dissemination, suitable for amateurs and experts alike.

Stage 4 (2017–2019) [Production period]. Incorporating the valuable lessons learned from user feedback of the prototype website, the Giza Project will construct the full-scale new public web resource.

The proposed work plan below covers the period of the DPP Prototyping grant (stage 3 above). Over the course of the twelve-month grant period, the Giza Project team (led by Project Director Peter Der Manuelian and supported by Egyptological staff Nicholas Picardo, Rachel Aronin, and Jeremy Kisala and technical artist staff Rus Gant and David Hopkins), in close collaboration with web designer(s), educators, and programmers, will construct the new public Giza website prototype, using the 3D model as one interface to access all the disparate types of linked and synthesized archival data contained in the Project’s database. At the start of the DPP grant period, the Giza Project Advisory Board will meet to review the final GizaCARD database product (created with the support of the previous NEH HCRR grant) and discuss the proposed design and content of the new Giza website.

The year of the DPP grant will include the new prototype website’s design, layout, and construction by a web team, yet to be chosen, in consultation and coordination with Harvard’s Faculty of Arts & Sciences Research Computing. For the prototype, we will focus on one pyramid complex, that of the Pharaoh Khafre, including its associated temples and the Great Sphinx. This manageable subset of the 3D Giza Plateau computer model permits us to choose and optimize solutions for site architecture, functionality, and heuristic components. It also provides the essential opportunity to identify bugs and troubleshoot before scaling up to the entire dataset and complete 3D model during a future Production phase of the Project. At every step of the prototype’s construction process, the site designer(s) will work in communication with the humanities advisers and digital production team to ensure an innovative and powerful yet user-friendly website that serves the needs of a broad and diverse audience. After a preparatory fact-finding round of local testing in January 2016, and a second, more extensive round of beta testing in October, the final months of the grant period will allow for detailed analysis of user feedback and browsing metrics to determine appropriate adjustments and enhancements to refine audience engagement.

Pre-grant period: Meeting with humanities advisers to discuss integration of GizaCARD database and 3D virtual model; preparation for creating JSON APIs to link the back-end SQL database (TMS) to the forthcoming public Giza website; mock-ups and design refinements

Jan. 2016:

Testing & Evaluation: Formative testing phase - events/focus groups at the Harvard Semitic Museum to solicit feedback from the museum-going public

Feb. 2016:

Testing & Evaluation: Analysis and integration of user feedback

Website construction: Khafre Pyramid model importation/incorporation into Unity; coding; database linking; optimization

Mar. 2016:

Website construction: Khafre Pyramid Temple model importation/incorporation into Unity; coding; database linking; optimization

Narrative video creation: Storyboard preparation of Gateways to Giza interactive video productions

Apr. 2016:

Website construction: Khafre Valley Temple model importation/incorporation into Unity; coding; database linking; optimization

Narrative video creation: Storyboard completion and database resource selection/integration for Gateways to Giza interactive video productions

May 2016:

Website construction: Sphinx model importation/incorporation into Unity; coding; database linking; optimization

Narrative video creation: Scripting of Gateways to Giza interactive video productions

June 2016:

Website construction: Sphinx Temple model importation/incorporation into Unity; coding; database linking; optimization

Narrative video creation: Scripting completion of Gateways to Giza interactive video productions

Testing & Evaluation: Meeting with Giza Project Advisory Board to discuss prototype website progress, first round of beta testing results, and narrative frames of the Gateways to Giza

July-Aug. 2016:

Website construction: Complete interlinking of archival data and 3D models, with possibility of GIS information as well

Narrative video creation: Construction of Gateways to Giza interactive video productions

Sep. 2016:

Website construction: Implementation and testing of overall plateau model and website navigation features

Narrative video creation: Review/revision of Gateways to Giza interactive video productions

Oct. 2016:

Testing & Evaluation: Beta testing phase - Amazing Archaeology Day and other special events to generate metrics about most popular/used/revisited sections of the site

Nov. 2016:

Testing & Evaluation: Analysis and integration of user feedback; troubleshooting links

Dec 2016:

Testing & Evaluation: Meeting with Giza Project Advisory Board to review the final website prototype and discuss feedback and improvements to website based on user evaluation; addition of supplementary tools and/or options to further enhance the user experience; planning/scheduling for subsequent scaled-up Production phase of the website

Final Prototype project white paper

K) Organization profile:

The Giza Project, a non-profit international initiative based at Harvard University, assembles information about all the archaeological activity at the Giza Pyramids of Egypt along with their surrounding cemeteries and settlements (3rd millennium BCE to present). Using digital archaeology, the Project unites diverse documentation to produce powerful online and traditional academic research tools and new teaching technologies. It presents academic information about Giza at all levels of expertise for the world community and strives to provide a model of archaeological information management. Harvard University, established in 1636, is devoted to excellence in teaching, learning, and research, and to developing leaders in many disciplines who make a difference globally. Harvard faculty members are engaged with teaching and research to push the boundaries of human knowledge. The University has twelve degree-granting Schools in addition to the Radcliffe Institute for Advanced Study, 2100 faculty, an enrollment of over 20,000 degree candidates, and more than 360,000 alumni around the world.

L) Fundraising plan:

Funding has come from the following sources:

- Andrew W. Mellon Foundation, New York: 2000–2011, \$3.2 million awarded to the Giza Archives Project, Museum of Fine Arts, Boston
- Leon Levy Foundation, New York: 2011–2012, \$240,000 awarded to the Giza Project at Harvard University
- Dassault Systèmes, Paris: 2010–2011, 2011–2012, \$400,000 awarded to the Giza Project at Harvard University
- National Endowment of the Humanities (NEH) Humanities Collections and Reference Resources (HCRR) grant: 2014-2016, \$300,000 awarded to the Giza Project at Harvard University
- Harvard University Faculty of Arts and Sciences Funding: 2013, \$40,000 in operating funds
- Harvard University Provost's Office: 2014, \$40,000 in operating funds
- Harvard University Extension School (DCE): 2014, \$50,000 in operating funds
- Lasky-Barajas Dean's Innovation Fund for Digital Arts and Humanities, Cambridge: 2015, \$12,000 awarded to the Giza Project at Harvard University

Since the Giza Archives Project's inception at the MFA in 2000 as a Mellon Foundation-funded project to digitize Giza data from the Harvard University–Boston Museum of Fine Arts Expedition, the director and PI has held a larger vision and has worked passionately to realize it step by step. His belief is that Giza, as the most famous archaeological site in the world, requires a dedicated, permanent, and sustainable centralized repository of all the world's knowledge about the site. Whether that repository is a physical institute, an online resource, or both, the goal is to preserve and disseminate Giza's rich legacy in new and exciting ways, not just for scholars but for the world community as well.

Now that the Giza Project and the PI are firmly established at Harvard University, the opportunities for sustainability and growth have never been greater. The academic and research mission of the University provides a perfect fit, since the research enhances the teaching and vice versa. Both the Museum of Fine Arts, Boston, and Harvard University are dedicated to long-term sustainability of the Giza work. The Project is also in discussion with several potential individual donors and corporate sponsors in order to fill any remaining gaps in the budget.

8. Design Document

The design of the new *Digital Giza: A Portal to the Pyramids* website will incorporate elements of both traditional and innovative user experience. Functionally speaking, it will integrate the cross-referencing and aggregating power of an intensive relational database of Giza data (as demonstrated by The Giza Archives Project site: www.gizapyramids.org) with the interactive, visual-spatial experience and real-time responsiveness of an immersive 3D model environment (as demonstrated by the Giza 3D site: <http://giza.3ds.com>). The centrality of site and place in the Giza Project's data structure provides a seamless point of crossover between the virtual Giza environment and the wealth of information contained in the interlinked database records. It is thus an ideal framework for smooth, click-through connectivity among these numerous kinds of interrelated digital archaeological materials and for shaping an online experience for website users. Website integration creates one large, multifaceted "information environment" in which users experience traditional documentary information immersively from the first-person perspective. Alternatively, archaeologically accurate 3D reconstructions function as gateways to the original, primary sources (photos, drawings, etc.) upon which they were "built."

The full Digital Giza website is an ambitious endeavor. This proposal lays out activities to design and build a fully-functional, but limited-scope Digital Giza Prototype, with these preliminary activities focused especially on two points: (1) achieving appropriate tone and level for narrative content and (2) arranging the technical aspects of website architecture to optimize function across all five major access routes, or "Portals." This prototype will be the basis from which the Giza Project will scale up to incorporate all of its holdings into a future powerful and comprehensive online resource. For this prototype website, a subset of the Giza Project's holdings was chosen, namely those associated with the Pyramid Complex of King Khafre of ancient Egypt's Fourth Dynasty (about 2555–2532 BCE). These include five completed 3D-graphic models of its constituent monuments (Pyramid, Pyramid Temple, Valley Temple, Great Sphinx, and Sphinx Temple) and all associated archival content: artifacts, site and object photos, excavation diaries, supporting primary and secondary documents, associated ancient and modern people, publications, etc.

1) Narrative Treatment

Since digital archaeology is a practical mode of multimedia experiential learning, a broad narrative frame surrounds the overall concept of Digital Giza, one that is enhanced by multiple smaller, more specific experiences. Some of these experiences are structured and guided; others are user-influenced or freeform. All of these promote engagements with our priority humanities themes through experiencing, using, appreciating, and preserving ancient history and its source materials, with Giza as the vehicle towards these ends. This overarching narrative treatment of the Digital Giza website can be summarized as: *experiencing digital archaeology*. Digital archaeology is, at its core, the study of the archaeologically-represented past through the use of a broad spectrum of digital tools and technologies. It may include high-end imaging and mapping methods employed by field archaeologists, as well as the 3D-visualized fly-through of an ancient temple that introduces ancient Egyptian religion to a seventh-grader. Digital archaeology can bring the sometimes obscure world of academic archaeological and historical research to more widely accessible avenues of public education and outreach.

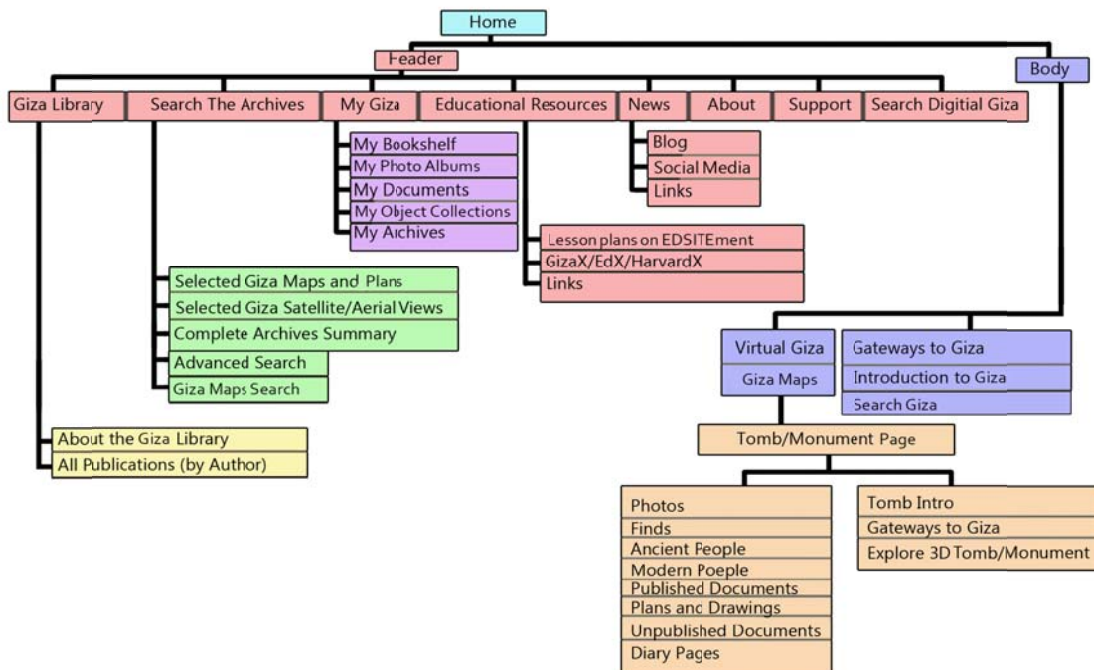
Through *Digital Giza: A Portal to the Pyramids*, public engagement with the "narrative of digital archaeology" will be realized as the sum result of numerous smaller, integrated encounters. Digital Giza will offer two broad categories of narrative: (1) semi-structured and (2) self-guided, often with the former dovetailing directly into the latter. Both types stress interactivity and contextualized engagement with the continually-expanding universe of archival and 3D-graphic resources curated by the Giza Project (for details of these narrative approaches, see description for "Gateways to Giza" below in Section 2: User Experience). A primary use of the year of DPP Prototype activity will be working out the structure, tone, and education levels of both interpretive texts and Gateways to Giza experiences. We provide here general, preliminary samples of such content to convey our current thinking. Through the year-long grant period, these key narrative components of the site will be further planned, composed, reviewed, and

finalized in close consultation with the specialist education and exhibition design members of our Humanities Advisory Board from the Harvard Museums of Science and Culture.

2) User Experience

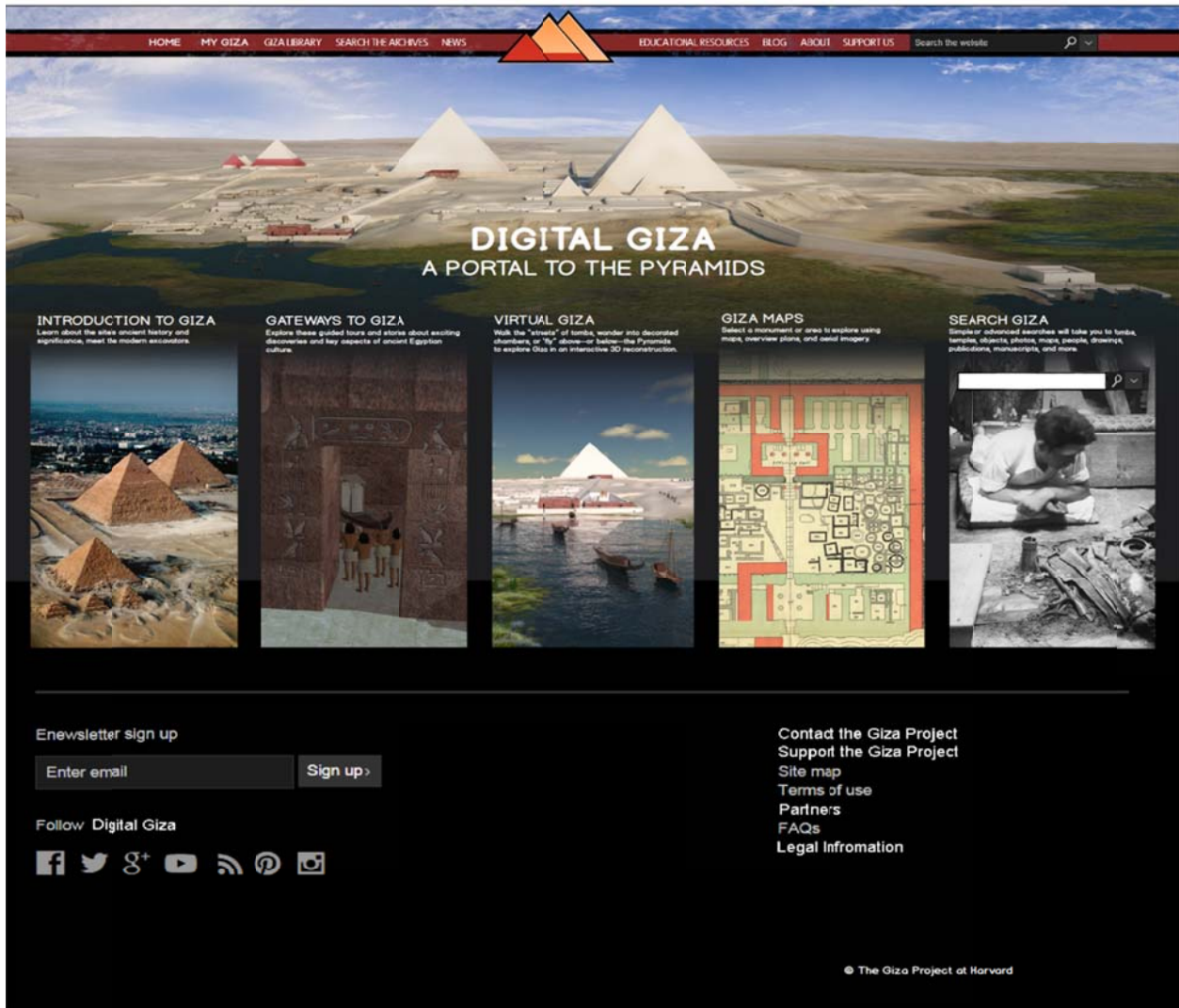
A core philosophy of the Giza Project is that digital archaeology is not merely an academic pursuit. It is also a fruitful process for targeted inquiry or curiosity in general. While modes of presentation and engagement vary, the data resources that can inform any of these levels of interest—from sixth-grader to seasoned scholar—are essentially the same, and the Giza Project at Harvard is the world’s most extensive repository of such material for this most popular archaeological site. For a given user of the website, what differentiates one route to discovery and knowledge from another is the nature of the toolset best suited for accessing, interpreting, and using the information. We are directing our choices for interface design and navigation options towards making Digital Giza as universally user-friendly, inviting, and intuitively functional as possible. Although the pyramids of Giza are already a major source of public fascination, we recognize that a convoluted, hard-to-use website would be counterproductive to the Giza Project’s ultimate goals of channeling the use of its resources to public benefit and enjoyment.

Site Structure and Navigation: Basic website navigation will operate through typical point-and-click hyperlinked text, icons, and graphics. A persistent menu bar of dropdown options will be accessible on all pages. The current blueprint for the website’s overall structure is represented in the following site map:



To orient online visitors while offering an immediate sense of Digital Giza’s potential and purpose, the home page (see below) will be clean and simple, with emphasis on visual cues over an abundance of text. The backdrop to the upper portion will be a photo-realistic rendering of the entire “Virtual Giza” model, the most detailed and accurate graphic reconstruction of the archaeological site to date. A persistent menu bar will be situated at the top of this and every page (about which, see additional detail below). The remainder of the page (aside from a footer) will be occupied by a very conspicuous visual menu of five large images representative of the Digital Giza interfaces to which they lead, respectively: INTRODUCTION TO GIZA, GATEWAYS TO GIZA, VIRTUAL GIZA, GIZA MAPS,

and SEARCH GIZA. Each of these five “Portals” will have a clear heading and a brief explanatory caption. They consist of four Access Points to Digital Giza content and experiences proper, alongside one link to basic introductory information for users who are either completely new to the archaeology of Giza or just need a refresher. From left to right, these Portals progress from general to more specialized with respect to the types and amounts of information available. Correspondingly, the amount of narrative guidance and “story-telling” provided to users decreases from substantial to none.



These five “Portals” or primary access routes into *Digital Giza: A Portal to the Pyramids* can be summarized as follows:

PORTAL #1: INTRODUCTION TO GIZA

Orientation Material about Ancient Giza and Giza Archaeology

This first Portal into Digital Giza will necessarily include more interpretive text than most other sections of the site—but with a twist. It will act also as a light tutorial for using the Digital Giza site. A visitor will be met with introductory prose about the histories of ancient Giza and Giza archaeology. Ample imagery will complement this text, to include site and artifact images, photos of excavators and excavations, 3D reconstructions of ancient Egyptians at Giza, etc. However, some text will function

additionally as mouse-over triggers and highlighted hyperlinks to activate pop-up content that characterizes the experiences through other Portals, such as instant database search results, conduits to 3D monument exploration in Virtual Giza, etc. In the **sample introductory** paragraphs that follow, underlined text signals responsive content that is described in brief by the accompanying footnotes:

Introduction to Ancient Giza

[Introductory text will be accompanied by a visual timeline of important Giza persons and events.]

The Giza Plateau of Egypt,¹ located about 15 miles southwest of modern Cairo, is one of the most important and famous archaeological sites in the world. It is home to the Great Pyramid,² the only one of the Seven Wonders of the Ancient World still standing. Built by King Khufu³ in the Fourth Dynasty of ancient Egypt's Old Kingdom⁴ (around 2550 BCE), the Great Pyramid was the largest ever constructed in Egypt, originally reaching a height of 481 feet. Two of Khufu's successors also built major monuments at Giza: Khafre,⁵ whose burial complex includes the second-largest pyramid⁶ as well as the Sphinx; and Menkaure,⁷ builder of the smallest of the three pyramids⁸ at Giza.

As these royal complexes were being constructed, and even for centuries after Egyptian kings began to build their monuments elsewhere, hundreds of tombs were systematically added to cemeteries surrounding the pyramids, to serve as the eternal resting places for the royal family and bureaucratic elite. Among these individuals were Khufu's mother Queen Hetepheres I,⁹ whose mysterious burial¹⁰ was hidden nearly 90 feet underground; the vizier (or prime minister) Hemiunu,¹¹ architect of the Great Pyramid; and Queen Meresankh III,¹² owner of a unique, beautifully decorated tomb¹³ east of her grandfather Khufu's pyramid.

The ancient Egyptian Old Kingdom¹⁴ (about 2650–2150 BCE) was a period of strong central government. Thus, it makes sense that its kings were able to organize the vast quantity of labor required for such vast building projects, and also that many officials chose to be buried at a site so near the capital, the focus of power. After the collapse of the Old Kingdom, however, came a time of weakened central control along with the rise of powerful local district rulers. In parallel to the decentralization of government and administration, there was a move away from

¹ Mouse-over pop-up of modern image of Giza

² Mouse-over pop-up of photo triptych: modern view of pyramid, early 1900's view, 3D-reconstruction view; linkable text to database monument record.

³ Mouse-over pop-up of statue of Khufu; linkable text to database profile page with information on Khufu, itself linked to all other relevant materials.

⁴ Old Kingdom will be highlighted on the visual Giza timeline.

⁵ Mouse-over pop-up of statue of Khafre; linkable text to database profile page with information on Khafre, itself linked to all other relevant materials.

⁶ Mouse-over pop-up of photo triptych: modern view of pyramid, early 1900's view, 3D-reconstruction view; linkable text to database monument record.

⁷ Mouse-over pop-up of statue of Menkaure; linkable text to database profile page with information on Menkaure, itself linked to all other relevant materials.

⁸ Mouse-over pop-up of photo triptych: modern view of pyramid, early 1900's view, 3D-reconstruction view; linkable text to database monument record.

⁹ Click to view 3D video featurette about Queen Hetepheres I; linkable text to database profile page with information on Hetepheres, itself linked to all other relevant materials.

¹⁰ Mouse-over pop-up of excavation-in-progress photo of Hetepheres' burial; 3D-reconstruction view.

¹¹ Mouse-over pop-up of statue of Hemiunu.

¹² Click to view 3D video featurette about Queen Meresankh III; linkable text to database profile page with information on Meresankh, itself linked to all other relevant materials.

¹³ Mouse-over pop-up of excavation photos of Meresankh's tomb; 3D-reconstruction view.

¹⁴ Old Kingdom will be highlighted on the visual Giza timeline.

the primary elite cemetery at Giza; instead, officials built their tombs at smaller regional burial grounds, closer to the now-prominent local centers of power. As a result, building at Giza tapered off, and was not resumed even with the reunification of Egypt under a single, strong dynasty during the Middle Kingdom¹⁵ (about 2060–1640 BCE).

After another period of fractured rule and civil war, Egypt rose to new heights of imperial power during the New Kingdom¹⁶ (about 1550–1070 BCE), when a resurgence of attention to Giza and especially the Sphinx¹⁷ occurred. Several pharaohs of Dynasties 18 and 19 built or added onto chapels in the area of the Sphinx, and Thutmose IV cleared away the sand which had buried the Sphinx's body after supposedly having a vision which promised him the kingship if he did so. This event was commemorated in a nearly 12-foot tall stone monument called the Dream Stela,¹⁸ which Thutmose set up between the paws of the Sphinx after the foretold events things had come to pass; the stela still stands there today.

When the New Kingdom¹⁹ ended, there was a final era of decline and political instability, followed by a period of foreign rule over Egypt, which was put to an end by the indigenous kings of Dynasty 26.²⁰ Having broken free of foreign control and established a new central government, they tried to legitimize their reigns by emphasizing their native Egyptian-ness. This included a surge of interest in Egypt's past, especially in the glory days of the Old Kingdom. Already ancient, the pyramids were one of the iconic images of Egypt, and so the elite returned once more to Giza, digging new burial shafts across the plateau—many of them intruding into the existing Old Kingdom structures.

While the pyramids identify Giza as the great royal necropolis of ancient Egypt's earliest state, the Giza Plateau²¹ preserves a much broader window onto the first flourishing of ancient Egypt, one of the world's first great civilizations. Tomb scenes capture snapshots of everyday lives and beliefs of Egyptians from all walks of life. Settlements²² offer opportunities to walk the same halls where ancient feet once tread. And burial remains inform a modern understanding of the lives of individual Egyptians. Although Giza thrived several millennia ago, connecting with ancient Egyptian culture now through Giza's history and archaeology provides insight into not only the differences but, more importantly, the many similarities that are shared between the ancient and modern experiences of being human.

Introduction to Giza Archaeology

[Introductory text to be accompanied by visual timeline of archaeological projects and milestones.]

A long history of construction, use, and reuse is part of what makes Giza so fascinating, complex, and valuable as a resource for understanding ancient Egypt. Famous in both ancient times and modern, the site has been the focus of exploration and excavation, from the time of medieval travelers to Napoleon Bonaparte's famous 1798 Egyptian expedition,²³ to modern scientific archaeology of the 20th century and now into the 21st. Aside from some early clearance work in the first half of the 1800s by the Frenchman Auguste Mariette²⁴, director of the first national service to monitor and safeguard Egyptian

¹⁵ Middle Kingdom will be highlighted on the visual Giza timeline.

¹⁶ New Kingdom will be highlighted on the visual Giza timeline.

¹⁷ Mouse-over pop-up of photos of Sphinx; 3D-reconstruction view; linkable text to database monument record.

¹⁸ Mouse-over pop-up of photo of Sphinx and Dream Stele; click to view English translation of hieroglyphs.

¹⁹ New Kingdom will be highlighted on the visual Giza timeline.

²⁰ Late Period will be highlighted on the visual Giza timeline.

²¹ Click to enter 3D Giza Plateau model.

²² Mouse-over pop-up of plans of recently excavated workmen's town; link to recent, public-friendly articles about these excavations (by Ancient Egypt Research Associates).

²³ Napoleon's expedition will be highlighted on the visual Giza timeline.

²⁴ Linkable text to database profile page with information on Mariette, itself linked to all tombs excavated by him.

antiquities, the earliest “modern” scientific investigation at Giza took place in 1842–43. At this time a Prussian expedition²⁵ led by Karl Richard Lepsius²⁶ (1810–1884) cleared and numbered several private tombs, entered the Great Pyramid, and drew maps and plans of the site. In 1880 the British archaeologist W. M. F. Petrie²⁷ set out for Giza, where he was able to record the most accurate measurements of the Great Pyramid and other monuments produced up to that time. He also investigated a few isolated private tombs in the Western Cemetery.

In the early 1900s, the Giza Plateau was divided into three sections,²⁸ with excavation rights granted to archaeologists from three nations: American George Reisner,²⁹ of Harvard University and the Museum of Fine Arts, Boston; Germans Georg Steindorff³⁰ and Hermann Junker,³¹ of the Universities of Leipzig and Vienna, respectively; and Italian Ernesto Schiaparelli,³² director of the Egyptian Museum of Turin. These excavations, along with work by Selim Hassan³³ and other Egyptian archaeologists beginning in the 1920s, produced the majority of data about Giza available today. The artifacts found by these expeditions, along with the photographs and records they created, are now scattered in collections across the globe in Cairo, Berlin, Hildesheim, Leipzig, Vienna, Turin, Philadelphia, Berkeley, and Boston,³⁴ to name just a few places.

In 2000, the Giza Project began to digitize and make available online the records at one of these institutions: the Museum of Fine Arts, Boston. The Project, now based at Harvard University, has since expanded its scope, and is now collecting all data held in international collections to build the most comprehensive repository of Giza-related information in existence—including early visitors’ accounts, archival records of the excavating institutions, right up to modern day reports of projects currently ongoing at Giza. After over a hundred years of thorough, scientific excavation, there is still so much we don’t know. By providing free online access to all this information, we hope to suggest possible avenues for future exploration and engagement by the public to help fill in the many gaps.

PORTAL #2: GATEWAYS TO GIZA

Interactive Media: Guided Tours and Narrative Pathways

Gateways to Giza provides a series of interactive video segments that take the user on a journey through time and space—to a land of pyramids, kings, and divinities, to moments of monumental archaeological discovery, to stories both ancient and modern. Sail down the Nile with Queen Hetepheres in her majestic royal barge. Excavate the pyramid complex of King Menkaure alongside archaeologist George Reisner in the early 1900s. Witness the discovery of the famous pair statue of the king and queen in January, 1910. With the aid of modern 3D modeling technology there are no limits to the stories we can tell.

These Gateway productions are based on two simple but versatile features: fly-through paths through the virtual Giza 3D models (“rails”) and interactive stopping points with responsive content. At any time users may pause the experience and look around themselves in 360-degree space. Each stopping point will also include this 360-degree viewing capability with a simple click and drag of your mouse, accompanied by 360-degree sound effects and audio narration, some upon arrival to a space and others

²⁵ Lepsius’ expedition will be highlighted on the visual Giza timeline.

²⁶ Linkable text to database profile page with information on Lepsius, itself linked to all tombs excavated by him.

²⁷ Linkable text to database profile page with information on Petrie, itself linked to all tombs excavated by him.

²⁸ Mouse-over pop-up of plan of 1902 division of Giza between American, German, and Italian concessions.

²⁹ Linkable text to database profile page with information on Reisner, itself linked to all tombs excavated by him.

³⁰ Linkable text to database profile page with information on Steindorff, itself linked to all tombs excavated by him.

³¹ Linkable text to database profile page with information on Junker, itself linked to all tombs excavated by him.

³² Linkable text to database profile page with information on Schiaparelli, itself linked to all tombs excavated by him.

³³ Linkable text to database profile page with information on Hassan, itself linked to all tombs excavated by him.

³⁴ Mouse-over pop-up of photo of all partner institutions.

triggered by activation of scene elements through clicks, mouse-overs, etc. There are two general types of Gateway productions: (1) guided tours and (2) narrative pathways. Both types are conceived to accomplish the following:

- to provide initial guidance and starting points, from which users can branch out on their own journeys of discovery
- to be inviting experiences that draw Digital Giza visitors further into the site, especially to make use of more free-form modes of exploration
- to introduce as many types of data resources as possible, placed in contexts that appropriately display their value, use, and relevance to the stories of ancient history and its modern reconstruction through archaeology
- to provide use and interaction choices to stimulate users' generation of their own questions to answer through further use of Digital Giza
- to present accurate and engaging information about ancient Egypt through Giza and its archaeology, while revealing the nature and uses of a variety of source materials

A viewer can choose to progress through these stopping points in a default sequence, thus following a prescribed path with transitional narration to provide interpretive flow, or they may selectively choose one at a time in any order from images just below the viewing window. At each stopping point users will find one or more of the following interactive features:


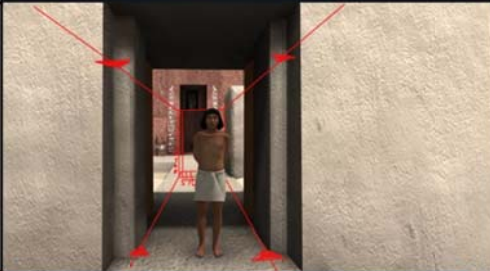
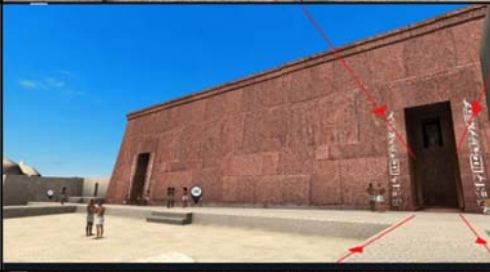


- 360-degree panoramic views where the user can look around from a realistic first-person viewpoint.
- clickable icons that bring up individual media files or model assets (e.g. excavation photos or modern pictures of a room or decorated wall, artifacts found in that space, field diaries describing work in the space, information on owners/users of the area, 3D reconstructions of artifacts).
- click-initiated database searches that yield database records about the monument, its contents, ancient and modern people associated with it, all available photography and video related to the space.
- active zooms into details of painted wall decorations, allowing viewers to get up close.
- pop-out content in the video (e.g. items depicted in tomb decorations can be, sometimes literally, “pulled off” the virtual wall in the form of 3D-modelled renderings, which the user may zoom and rotate in 360 degrees (Section 7: Images, Figure 4).
- mouse-over triggers for audio, environmental sounds, and avatar character voices to further narrate or enhance a scene and guide users.






True to their names, these interactive video experiences will leave viewers off at a “gateway” (i.e. viewing window) to the 3D model of the monument in/at which they have ended their journey, so that they may freely continue further along their own self-guided paths.




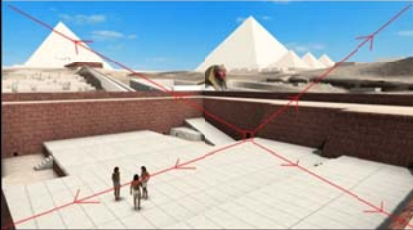
Prototyping activity for this 2016 DPP grant will build two Gateway to Giza productions centered on the Khafre Valley Temple, a constituent monument of the Khafre Pyramid Complex on which the Digital Giza Prototype will be based. Using the same monument to produce both one guided tour and one narrative pathway type of experience, we hope to exhibit the expansive range of stories and experiences that can be manifested in a single “space” of the 3D Giza environment, which can then be extended almost infinitely as the rest of the monuments are incorporated into the full website. The following descriptions reflect our preliminary conceptualizations of these two productions, which will be expanded, re-worked, revised and completed in coordination with our Humanities Advisory Board members:

Example 1: Guided Tour Type of Gateway to Giza (Section 7: Images, Figure 3): “Khafre’s Valley Temple”

Upon selecting this Gateway to Giza, the viewer will be given options to choose from a list of basic topics that commonly arise with ancient Egypt, such as Art, Architecture, Religion, Daily Lives and Activities, Pharaohs, Queens, and other Egyptians, and Archaeology, among others. This choice will determine the “walking path” through the Valley Temple, the array of specific stopping points, as well as the interactive content that will be encountered and the database materials to which the video will link. A separate browser window will house the simple navigational scheme of a larger video viewer window, below which is a horizontal line of thumbnails that correspond with the various stops on the tour. Clicking play will start the experience from the default first stop with introductory voice-over narration to introduce a narrator, set the stage, and begin the tour. Clicking instead on another stopping point will go directly to that point and commence with its narration to orient the viewer to that space, offering options to click on objects and icons to initiate responsive pop-up and linked content, or on avatars to cue them to speak. The figure below is a sample, partial storyboard for a tour path that presents the Khafre Valley Temple through a discussion of art, specifically its statuary.

PAGE	SERIES / PROJECT	EPISODE TITLE	CODE	Digital Giza
1/3	Digital Giza	Introduction to Khafre Valley Temple		
SCENE	LAYOUT - WIDESCREEN - ASPECT RATIO 16:9		ACTION - DIALOGUE - NOTES	PANELS
1.0			<p>This tour begins flying over the harbor westwards towards the valley temple of King Khafre, owner of the second (middle) Giza pyramid.</p> <p style="text-align: right;">INT EXT / DAY NIGHT</p> <p>Users may pan to left or right, viewing the Sphinx, Sphinx temple to the right, and boats in the harbor.</p>	
1.1			<p>The camera slows as it approaches the northern (right) of the two temple entrances.</p> <p style="text-align: right;">INT EXT / DAY NIGHT</p> <p>A priest stands in the doorway to welcome us.</p>	
2.0			<p>Flanking the entrances are hieroglyphic texts dedicated to two important goddesses: Bastet on the north and Hathor on the south.</p> <p style="text-align: right;">INT EXT / DAY NIGHT</p> <p>Slow stop for 12 seconds at the front of the temple's northern entrance.</p>	
2.1			<p>Clicking on the inscriptions (which could "glow" upon mouse rollover to indicate they are actionable), will produce their English translations. Images of the goddesses may also appear, with identifying text.</p> <p style="text-align: right;">INT EXT / DAY NIGHT</p> <p>We enter the temple through the northern door and turn left.</p>	
3.0			<p>We come to a stop in the north-south corridor passage, paved with alabaster flooring tiles.</p> <p style="text-align: right;">INT EXT / DAY NIGHT</p> <p>It was here that in 1860 French Egyptologist Auguste Mariette discovered a pit filled with about 23 fragmentary royal statues.</p>	

PAGE	SERIES / PROJECT	EPISODE TITLE	CODE	Digital Giza	
2/3	Digital Giza	Introduction to Khafre Valley Temple			
SCENE	LAYOUT - WIDESCREEN - ASPECT RATIO 16:9	ACTION - DIALOGUE - NOTES		PANELS	
3.1		<p>Users may click on an area indicated on the floor to reveal the pit with statues. One statue was in nearly perfect condition: the seated statue of King Khafre, in a dark stone called anorthosite gneiss.</p> <p style="text-align: right;">INT EXT / DAY NIGHT</p> <p>Clickable links reveal descriptive text, the computer model of the statue, and actual photos of it in the Egyptian Museum, Cairo today.</p>			
4.0		<p>The temple's floor plan resembles a T shape. We move on into the pillared hall.</p> <p style="text-align: right;">INT EXT / DAY NIGHT</p> <p>Users may pan around to view the huge granite pillars, quarried hundreds of miles south of Giza at Aswan, and transported north on barges.</p>			
4.1		<p>Clickable buttons toggle/dissolve the view back and forth between the computer model, vintage black-and-white photos, and present day color images of the pillared hall.</p> <p style="text-align: right;">INT EXT / DAY NIGHT</p> <p>Many "then-and-now" views, each taken from the same angle, show the changes to the temple over time.</p>			
4.2		<p>As we move through the temple, we see some of the 23 statues, in varying sizes and materials, set up against the granite pillars.</p> <p style="text-align: right;">INT EXT / DAY NIGHT</p> <p>A view down the south wall, looking west, brings us face to face with several of the Khafre statues, while priest hover nearby, lending a sense of human scale.</p>			
4.3		<p>We can observe the priests performing certain rituals before the statues.</p> <p style="text-align: right;">INT EXT / DAY NIGHT</p> <p>Several of the statues have survived, in various states of preservation. Users can click on individual statues for photos and additional information.</p>			

PAGE	SERIES / PROJECT	EPISODE TITLE	CODE	Digital Giza
3/3	Digital Giza	Introduction to Khafre Valley Temple		
SCENE	LAYOUT - WIDESCREEN - ASPECT RATIO 16:9	ACTION - DIALOGUE - NOTES	PANELS	
4.4		<p>Statues of Khafre today are in several museums around the world, such as Cairo, Hildesheim, and Leipzig. Reconstructing the original statue layout program is one of the great puzzles presented by the Khafre Valley Temple.</p> <p>INT EXT / DAY NIGHT</p> <p>Text buttons describe the various materials of the statues, and name the different quarries around the country from which they originated.</p>		
4.5		<p>We continue our tour with a slow pan down the pillared hall.</p> <p>INT EXT / DAY NIGHT</p> <p>With a click, individual priests could explain the nature of their temple duties, including their ritual spells meant to preserving the deceased king's mortuary cult.</p>		
4.6		<p>We head towards the back (west) of the temple, the likely location of the famous seated Khafre statue that we viewed in the pit in the corridor passage.</p> <p>INT EXT / DAY NIGHT</p> <p>The scene inside the temple then fades to black, as we prepare to leave the temple.</p>		
5.0		<p>We pan back from the darkness to emerge from the valley temple. We hover above the structure and see the Sphinx just to the north, the Sphinx temple, and Khafre's causeway leading westwards up the plateau to his pyramid.</p> <p>INT EXT / DAY NIGHT</p> <p>All of these major monuments will eventually be "clickable," allowing the user to jump to these new locations, and to experience other interactive, educational tours.</p>		

Example 2: Narrative Pathway Type of Gateway to Giza: “Discovering a Masterpiece: The Statue of King Khafre”

Concept: In the mid-19th century, prior to the development of sound archaeological method, Egyptian Antiquities Service founder Auguste Mariette did not keep detailed diaries of his excavation work. But if he had, we might imagine a diary entry of his—and bring the Digital Giza user into his world at the time—as follows:

Text added in *[italics and brackets]* below describes some of the interactive features that users may experience in following this narrative short story.

[Clicking on this Gateway story takes the user to the Giza interactive computer model, moving from a general view of the Khafre Valley Temple, through the northern entrance, and into the corridor passage.]

Mariette: “In 1860 I unearthed what I believe is one of the greatest works of three-dimensional sculpture from any site or era in Egyptian history: the seated stone statue of the pharaoh Khafre. The king rests on a seat carved with lions’ heads and legs, and is protected by the falcon god Horus, whose outstretched wings surround his head. The statue came to light in a pit sunk into the corridor passage towards the front of the temple. *[A highlighted section of the alabaster-tiled flooring dissolves upon mouse click to reveal a pit filled with statues and statue fragments.]* There were also fragments of about seventeen other statues in the pit. The royal beard, *nemes*-headdress, and hieroglyphic inscriptions

confirm the king's identity. *[By clicking on the Khafre 3D statue model, the user accesses the database record containing all the relevant information: old and new photos, drawings, bibliography, translation of the hieroglyphic inscriptions, etc.]* On the side of the seat appear the two plants, papyrus and lily, tied together to symbolize the unification of Upper and Lower Egypt. *[Users may select and rotate the computer model image of the statue to view it from all angles, including the floral motif on the seat of the seat.]* I was most struck by the image of the god Horus; he takes the form of a falcon perched behind the king's head, stretching out his wings in a gesture of protection. Never before have I seen the images of god and king so movingly combined. Even the king's gaze seems to look beyond any of us mortals standing before him into the distant horizon. Once I set this statue up on display in our new museum, visitors will marvel at this regal pharaoh for generations to come." *[Users may click on a selection of recent color detail images of the actual statue, housed today in the Egyptian Museum, Cairo.]*

Today, geologists call the stone used for the statue anorthosite gneiss, and we know that it came from Gebel el-Asr, hundreds of miles south of Giza, in Egypt's western desert. *[A map of Egypt will appear, showing the location of Gebel el-Asr in Egypt's southwestern desert.]* Perhaps no other statue from ancient Egypt shows the idealized form of the powerful, confident ruler from the Pyramid Age as successfully. It may have occupied a very special place inside the temple, among more than twenty other statues of the king. *[From the statue pit in the corridor passage, users may navigate the computer model to enter into the pillared hall. Here they can view restored statues of Khafre placed up against the granite pillars. Panning past these statues, they arrive towards the back of the temple, perhaps the original location of the famous seated statue of Khafre. Ancient Egyptian animated priest characters may be added to the scene, to lend a sense of scale, and to demonstrate the types of ritual gestures and responsibilities of the temple's personnel.]*

Ironically, Mariette never made the connection of the Valley Temple with Khafre. *[A 360-degree interactive panorama from the standpoint of the statue pit allows the user to view the corridor passage surrounding the area of discovery.]* He puzzled over whether it was an addition to the Sphinx complex or vice versa, one of the many uncertainties about the ancient site that continued exploration has helped to solve. But many more mysteries await... *[To explore the architectural relationships between the Khafre Valley Temple, the Sphinx and Sphinx Temple, users may pan out to an aerial view above all three monuments. A toggle switch will dissolve the view between the computer model rendering and actual aerial photographs of the area. At any time, users may jump to these other monuments to read descriptive text, navigate the computer models, and view additional images.]*

There are unlimited numbers of stories to tell to excite the imagination and stimulate further investigation. What better way to "rediscover" the lives and material culture of the ancient Egyptians than by placing the visitor at the find spot or, better yet in some cases, the very spot where ancient Egyptians made use of artifacts? Or, as in the case of Example #2, to allow one to be present at the very moment of a momentous archaeological discovery?

As these two brief, very preliminary glimpses of Gateways illustrate, many stories can be told through the same virtual space because of the extensive and diverse types of resources that can be "brought into play" for viewers. These video productions will explore such topics as Egyptian funerary ritual, the economics of tomb building and social structures, the development of Egyptian art and writing, the significance of archaeological context, the excavation history of the site, the shifting role of archaeology in Giza's ongoing history, and issues of cultural patrimony/repatriation. Unlike the free-ranging 3D navigational framework available in Virtual Giza (see immediately below), which is non-linear by nature and specific to the individual user, these Gateways will help orient and guide the user to and through Giza, following a (technically) fixed, but still interactive and engaging trajectory to illuminate key themes of ancient Egyptian culture and its place in the humanities.

PORTAL #3: VIRTUAL GIZA**Individualized Interactive Exploration for the Public**

Entering through this Portal from Digital Giza's home page, users will have the Giza Project's entire 3D graphic model of the Giza Plateau, with all its monuments and features, spread out before them. Much like the initial screen of the Giza 3D website's (<http://giza.3ds.com>) graphic model environment, they will have real-time control over the gently rotating model. Movement of the mouse pointer around the model will highlight sections of the Plateau (Section 7: Images, Figure 5). Clicking a section (e.g. a pyramid, temple, cemetery, etc.) will zoom to that area (Section 7: Images, Figure 6). From this closer perspective, individual monuments and features can be selected, with highlight colors indicating generally what level of information and experience are available for the selected item (e.g. data only, Gateways to Giza, fully immersive exploration). Clicking a monument will open its introductory database (GizaCARD) record page in a new window (Section 7: Images, Figure 8), including where applicable an "entrance" to the full 3D model of tomb, pyramid, temple, house, etc. With this functionality Virtual Giza is far more than just a sophisticated environment for sightseeing an ancient setting; it is also effectively a virtual reality search engine for all of the Giza Project's holdings. A pull-down survey menu will accommodate those Virtual Giza visitors who wish to focus only on monuments that allow them to explore immersively, while those who know specific monument names and tomb numbers can use a simple search bar to go directly to their targeted destination.

Whether navigating around the entire Giza Plateau or inside an individual monument in the 3D environment of Virtual Giza, the user will experience space from a first-person perspective. All space will be enhanced with responsive content throughout, of the same variety as described above for Gateways to Giza video experiences. Small icons and rollovers will indicate embedded photos and other pop-up content, and the location of (and links to) artifacts; these will help guide the user to supplementary information and archaeological data from expeditions dating from the 1840s to the present day. This approach moves from the general to the specific: from navigating through the rooms of a temple, down to a single artifact found in a specific chamber, with direct access to its modern archaeological records and associated interpretive documentation. In addition to this path, navigation in the opposite direction is also available: users may start with a single artifact, such as a statue, and move from its descriptive data to its discovery photographs, and up many "levels" of generality to its findspot, its tomb of origin, and back out to the overview model of that region of the Giza Plateau. Searches that reveal data will thus be available in all directions: top-down, bottom-up, and side-to-side. Furthermore, because of the integration of the 3D graphic environment and the Project's underlying database holdings, daily data "refreshes" will ensure that the information available to public users of the site constantly reflects the maximum available at any given time.

PORTAL #4: GIZA MAPS:**Visual and Spatial Searching by Map Views**

The Giza Maps Portal is a simple yet extremely powerful user interface for both novice and expert users. It is based upon the widely familiar format of popular online mapping applications such as Google Maps, Mapquest, Bing Maps, and Yahoo Maps. Upon entering Giza Maps the browser window will show a top view map/plan of the entire archaeological site of Giza and the immediately surrounding landscape (Section 7: Images, Figure 7). Navigational tools will consist of a customary array of pan and zoom functions. Additionally, however, a visitor will be able to use a selections tool to draw a boundary around an area of interest that includes multiple monuments. This selection will initiate a real-time data search with parameters defined spatially by the selected area, i.e. a search for information on every Giza monument and feature within the boundary lines. Just as Google Maps sites online have satellite views in addition to street map views, Giza Maps will offer several overlays for these searches, which may include multiple maps, satellite imagery, an aerial view, and a top view of Virtual Giza.

These capabilities offer some significant advantages for every level of user. For instance, this manner of selection allows anyone to search for information spatially, even if just "browsing" casually,

because it requires no specific identifying information about Giza monuments such as tomb number or names of occupants. If an area looks interesting for any reason, a user can access more information about all monuments within it in an instant. This constitutes a kind of bulk searching that other sections of Digital Giza do not provide.

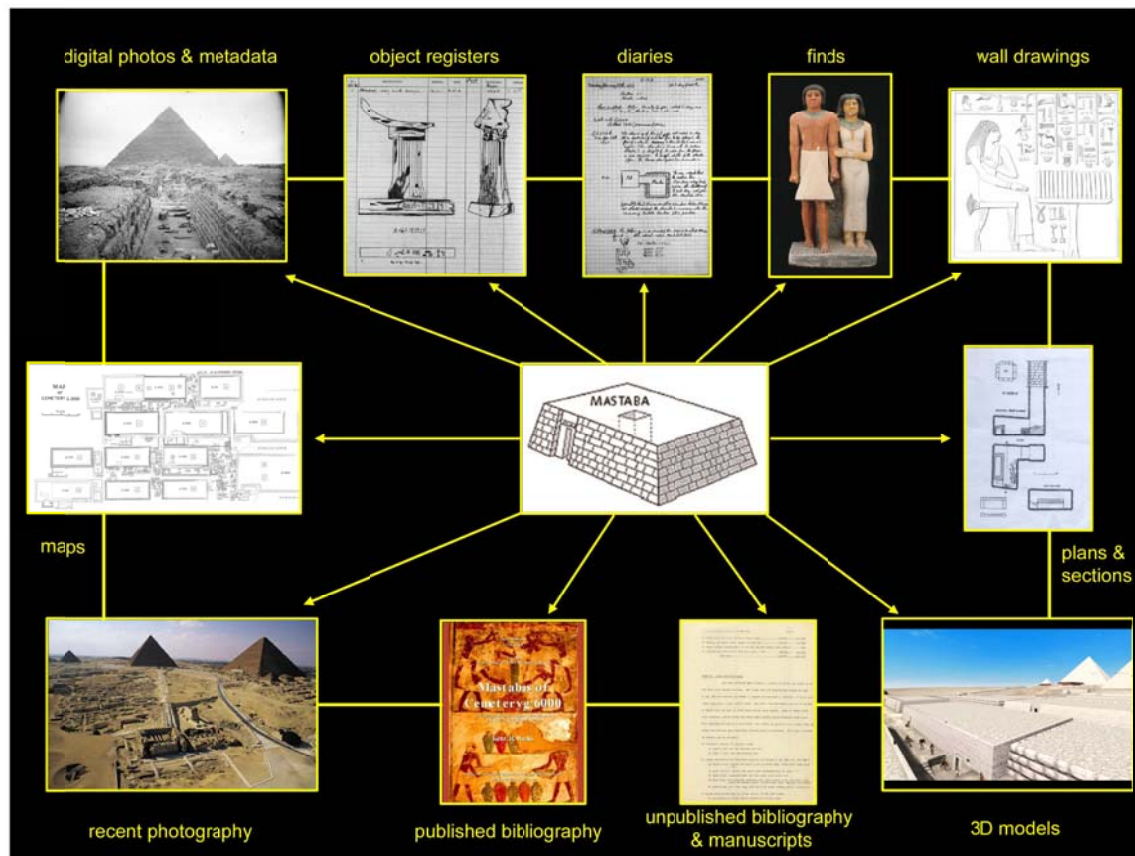
This Portal looks ahead to future objectives beyond the DPP grant term for the development of Digital Giza, both as a public site and as a research tool. Whether Giza Maps will be built upon the architecture of Geographical Information Systems (GIS) through ArcGIS infrastructure or by the somewhat simpler native capabilities of the Unity virtual environment and game engine, we will be able to add additional maps, plans, and views into Giza Maps (see below, Section 3: Technical Specification for more details). As more and more legacy maps are geo-rectified (i.e. oriented to real-world spatial coordinates) by the Giza Project and others, it may become possible to allow users, upon pulling up a map image in its database record, to immediately view it slotted into the Giza Maps view to understand its relationship within the wider Giza landscape, and then run spatial searches with the selection tool accordingly. Ultimately it may even become possible to allow users to upload their own maps which, if marked up with the appropriate spatial information, could be used within the Giza Maps window. Eventually we also hope to implement a feature similar to the “Google Street View” function. However, this will require systematic spatial recording on the ground at the site of Giza first. In the shorter timeframe, the 1,300 360-degree QTVR panorama files created by the PI at Giza will eventually be linked to appropriate coordinates on the Giza Plateau and be accessible via Giza Maps.

PORTAL #5: SEARCH GIZA

The Giza Consolidated Archaeological Reference Database (GizaCARD)

The Giza Consolidated Archaeological Reference Database (GizaCARD) is the Giza Project’s core data management platform. The result of the processing, standardization and cross-referencing of thousands of digitized documents and media related to Giza’s archaeological record, it provides the content and back-end organizational underpinnings of all aspects of the proposed web resource, in a relational database framework that is logically structured specifically for site-oriented archaeological data. As an ongoing practice, the Giza Project continues to incorporate new data resources into GizaCARD as they are received and processed.

A non-hierarchical configuration of relationships among different types of data records in GizaCARD allows users to introduce queries moving from more general to more specific or, conversely, from more narrow searches to broader ones. GizaCARD was developed with a site-centric organizational structure that optimizes the database for the idiosyncrasies of archaeological datasets. Sites are the central nodes in a complex web of relationships among data types that are catalogued and interrelated by the database. The database organizes these relationships as background data tables from which both simple and complex queries can be quickly performed through the database itself or, more importantly, via online searches through the new website. The schematic data structure diagram below illustrates an example of these interrelationships.



Additionally, this centrality of site and place in our data structuring offers a seamless point of crossover between the visual-spatial aspects of the virtual Giza environment and the vast related information contained in GizaCARD records—in essence, the data offer points of access into structures built in the virtual environment, and vice versa. The integration of the synthesized archival data of GizaCARD with the visual and interactive capabilities of a 3D model interface advances a new paradigm for information management and dissemination for complex archaeological sites, not the least because it offers optimal versatility for the widest array of end users.

In order to query the database, a free text search box is located on the persistent menu bar at the top of all pages of the website, providing familiar, easy-to-use, “Google-style” searching. Simple searches like these may also be initiated via the “Search Giza” Portal on the home page. Likewise, users with more defined and/or specific interests can choose the Advanced Search option via this portal (Section 7: Images, Figure 10), which provides for focused searches in multiple fields, with Boolean operators, etc. Pages displaying search output will have options for further refining the results. All searches through the Digital Giza website will access GizaCARD data via a customized Application Program Interface (API) that optimizes the quality and speed of searching (see below, Section 3: Technical Specifications).

The thoroughness of record entry into GizaCARD is essential to providing optimal paths for research and casual exploration in the future web resource. Considerable depth and breadth of data interrelationships are required for the individualized interactive experiences with the data, which will vary primarily on the basis of how deeply into the data visitors wish to go. For instance, users who want to assemble all the diverse material available for a given object (e.g., a statue) may conduct a search by object accession/field number, and retrieve all original documentation— excavation and in-situ photos, modern color studio imagery from its home institution, field diary entries describing its discovery, object

register entries, architectural plans of its findspot and archaeological context, packing and shipping information, as well as published and unpublished manuscripts—associated with that artifact (for examples of GizaCARD data holdings, see Section 7: Images, Figures 15-24).

The incorporation of data from multiple international institutions is especially valuable for users asking questions about objects or monuments that were explored by more than one expedition, and whose associated notes, photographs, and objects are now stored around the world. Such was the case for tomb G 5480, which was excavated by both the Harvard-MFA and German/Austrian missions, and was never fully published. A search for this tomb (via tomb number or tomb owner’s name) will return information on objects found in and around the tomb: four copper tools, seven alabaster dishes, a canopic jar and fragments of three lids, and five statues of the tomb owner now housed in Boston (Museum of Fine Arts 13.3447), Cairo (Egyptian Museum TR 20.1.41.4), Vienna (Kunsthistorisches Museum ÄS 8543), Cambridge (Fitzwilliam Museum, E62.2926) and Hildesheim (Pelizaeus-Museum 2407). The search results will also include archival material from the Harvard-MFA expedition (stored in Boston) and the German/Austrian expedition (stored in Vienna): curatorial photographs of the artifacts (six from Hildesheim, eight from Vienna, four from Boston), daily diaries (one from Vienna, 17 from Boston), and excavation photographs (seven from Vienna, 16 from Boston); as well as seven maps and plans and 31 pages of unpublished manuscripts from Boston. Reintegrating these scattered data, a search query to GizaCARD enables a more holistic understanding of a given site than would otherwise be possible, providing opportunities for new research and exploration.

Introduction View (default) vs. All Data View

Many records in the database have dozens of different associated pieces of data. To prevent “information overload” for casual or first-time users—while also not presuming to dictate how much or little data any given user may ultimately wish to access—every data record will have two possible views: an “Introduction View” (Section 7: Images, Figure 8) and an “All Data View” (Section 7: Images, Figure 9). In reality all data is available in both views. However, the more expansive data display in the All Data View is collapsed out of sight (so as not to be overwhelming at first glance) in the Introduction View, which is the default view for all records. This view shows a primary image and basic descriptive profile for the monument, document, image, person, movie, publication, etc. that has been pulled up by the user. Links to all associated types of data specific to this particular record will be visually displayed nearby as icons that name the categories of available information. The All Data View will display everything available in the GizaCARD holdings, presented comprehensively but in clearly defined categories of information to aid those less familiar with archaeological data.

Other functionalities accessible from Digital Giza home page:

“MY Giza” Personal Archiving: Users who create a (free) login profile can save their own collections chosen from the full Digital Giza holdings (except “live” 3D models). Every data record—whether for a photograph, tomb, pyramid, archival document, etc.—will include an icon to instantly save that resource to a My Giza folder. Personal collections can be accessed at any time while using Digital Giza via a pull-down “My Giza” menu from the persistent header. Saved materials will be categorized automatically by resource type. Users will have My BOOKSHELF (i.e., publications from the Digital Giza Library); MY PHOTO ALBUMS (i.e., photographs of any kind); MY DOCUMENTS (i.e., excavations diaries, artifact lists, unpublished manuscripts); MY OBJECT COLLECTIONS (i.e., Giza artifacts and objects); and MY ARCHIVES (i.e., all material saved by the user regardless of classification). In the My Giza browser window, these archives will be situated as a tabbed index with one archive active at a time. Contents of the active archive (“My Photo Albums” in Section 7: Images, Figure 11), will show up in two columns, column 1 to scroll through existing folders of saved records, and column 2 to display a scrolling preview (thumbnail image and filenames) of a selected folder in column 1. For ease of organization, users will be able to name their own folders. Occupying the rest of the page’s width is an image viewer to display an image selected from those in column 2. The viewer will display the highest-resolution image held by the Giza Project to allow for as much detail as possible when using

pan and zoom tools in the viewer. (Note: downloads and sharing through social networking will utilize reduced-resolution versions of the image).

Social Media: We regard the integration of popular social media sites to be an important method to extend the Digital Giza experience beyond the website itself. The ability to share their own “finds” from Digital Giza through social media allows users to project their own present conceptions and appreciation of the Giza material into a very modern, public form of communication. This model of distribution is itself a mode of both re-contextualization of the material and a type of preservation for the future. The Project itself will maintain a presence on pertinent social media sites, as well as posting periodic updates to our blog (Section 7: Images, Figure 13).

Digital Giza Library: A very important, if perhaps unassuming component of Digital Giza will be the world’s largest free online Giza digital PDF library (Section 7: Images, Figure 12), composed of out-of-copyright publications and copyrighted materials for which we have requested and received appropriate permissions to post. Users may access the library directly via a drop-down in the persistent header of the website, or they will find library contents linked to other sections of the site, including Virtual Giza, Gateways to Giza, and certainly in results of Giza Search and database records. The Giza Project’s bibliographic work produces not just references in database fields, but also PDF files of publications themselves, linking literature to all the relevant records in the database, and opening/downloading the PDF file immediately on the user’s computer. The digital library section of our previous Giza Archives Project website was one of the most extensively visited sectors of the site. Paper sources are scanned at 300/600 dpi, as determined by such factors as quality of original, color versus b/w format, proportion of text to images, etc. All are post-processed with Adobe Photoshop (CS5 or 6) for orientation and clean-up to produce dependably high-quality output that is consistent with the paper originals. PDFs are processed with ABBYY FineReader optical character recognition software at highest sensitivity settings and checked manually to render text optimally searchable. For publications that are made available in GizaCARD—and eventually online as the largest Giza-related electronic library—links are made to records for Giza people, places, and objects that are discussed therein, so that bibliography is actually embedded into the system.

3) Technical Specifications

Site Architecture: Digital Giza website architecture will be grounded primarily on HTML5 and Java-based scripting to accommodate both current and immediately foreseeable standards of web and mobile compatibility, while also avoiding pitfalls endemic to the choice of declining formats (e.g., Flash-based content). Some of the specialized functions will require embedding of additional software and coding solutions. The selection of the optimal suite of software and adoption/creation of Application Program Interfaces (APIs) is a major part of the proposed DPP prototyping activity. We have researched and consulted already with specialists to narrow the list of probable best candidates for the following Digital Giza functions:

Virtual Giza & Gateways to Giza Interactive Videos: Whereas our past collaboration on the Giza 3D site required an architecture that relied on embedded elements of (proprietary) Dassault Systèmes’ Virtools and 3DVIA software, we favor open-source solutions where possible and practical. Although not 100% open-source, the Unity game engine (Unity Technologies, <http://unity3d.com/unity>) is a recognized leading standard for interactive 3D-graphic content, especially games, with significant open-source components. Unity is one of the most versatile full-featured engines for media experiences across online computing and gaming platforms. In this regard, it is the best choice for accommodating the hardware configurations of the widest possible user base. Aside from offering the full array of realistic, real-time capabilities of a robust gaming engine, Unity will bring dynamic lighting and shadowing to Virtual Giza for the first time. The Giza Project has already begun reformatting and optimizing some existing models for Unity. Release and use of our 3D media online is further facilitated by broad support of the free Unity Web Player in the most common web browsers (Firefox, Chrome, Internet Explorer,

Opera, and Safari in Windows; Safari, Firefox, and Chrome in Mac OS X and newer). Gateways to Giza media productions are, technically speaking, executable files that launch in the Unity Web Player.

Database, Data API, and Searching: GizaCARD runs on The Museum System (TMS) platform (www.gallerysystems.com). TMS is a SQL (structured query language) database built of discrete modules that are cross-referenced to one another. It is a relational database, meaning the relationships between records in these modules are web-like, as opposed to hierarchical. TMS modules include Sites (pyramids, tombs, temples, settlements, large archaeological features, etc.), Objects (archaeological finds, archival documents, documentary records, organic and human remains), Media (photographs, QTVR views, movies, audio clips, etc.), Constituents (ancient and modern people, groups and institutions), and Bibliography (relevant published and unpublished works). The TMS software organizes these relationships as background data tables from which both simple and complex queries can be performed through the database itself or, more importantly, via online searches. These tables can, however, be somewhat limiting in search sophistication, intuitiveness, and speed.

Therefore, Digital Giza will have an intermediary API that will be fed by GizaCARD data. This API will function as an interchange to run data distribution to the Digital Giza site. Currently we expect to structure this important API as JavaScript Object Notation (JSON, <http://json.org/>), an open-source format designed for exchanging data between server-based applications (such as databases) and the web. JSON brings several advantages. For coding, it is lightweight, i.e., easily read by both humans and machines, which dramatically facilitates the rapid prototyping of web output that draws on the API. It is also language-independent, meaning it complies with most other common coding languages. We regard this built-in flexibility as a safeguard for future development of both Digital Giza and the web in general. JSON is currently the chosen data-interchange format for Harvard Art Museums websites, so the Giza Project will have institutional support in its implementation.

A number of search solutions are available for Digital Giza, both open-source and proprietary. We seek a familiar Google-like intuitiveness and range to accommodate individual search styles. This is to say, we want Digital Giza output to be as logically and helpfully responsive to the question “How long did King Khufu rule Egypt?” as it is will be to a user inputting Giza tomb number “G 2000.” A custom Google search engine (<https://cse.google.com/cse/>) is one option we will explore. Similarly, IBM’s Watson Explorer, <http://www.ibm.com/smarterplanet/us/en/ibmwatson/explorer.html> is based on “cognitive exploration” of large datasets, a novel search method that might be well-matched to the Giza Project’s substantial holdings. However, an open-source search option that has been recommended for us by members of our Production Team is Elasticsearch (<https://www.elastic.co/products/elasticsearch>). Since it is optimized for JSON-formatted documents, it promises to work efficiently with our envisioned JSON API for optimal user searching experience. (As one Production Team members says, “It’s insanely fast.”)

Giza Maps and GIS Undercarriage for Virtual Giza Basemaps: As mentioned in the Project Narrative, it is our aim to ground the Digital Giza’s 3D model environment and 2D map interfaces in real-world space consistent with a standard global coordinate system, i.e., the Universal Transverse Mercator system (UTM). Aside from being best practice, this step will establish a foundation in which Digital Giza map-oriented data will be compatible, and receptive to, other maps that have been formatted in UTM coordinates, as well as viable for use in common Geographical Information Systems (GIS) programs (e.g., ArcGIS). Although full embedding of ArcGIS functionality is possible via APIs, we will assess if this is necessary or if the same functionality can be achieved through simpler native tagging capabilities in Unity. We are especially interested in testing an open-source map layering-and-searching API called OpenLayers (<http://openlayers.org/>). Previously it has been deployed successfully for archaeological maps by the Digital Gordion Project (<http://sites.museum.upenn.edu/gordion/>), which has piloted for an offline archaeological research tool the type of spatially-oriented searching of archaeological data (maps only) that we seek for Giza Maps. Dr. Gabriel Pizzorno, a member of our Humanities Advisory Board, has been one of the developers of Digital Gordion.

Embedded Image Viewer: Photographic media is virtually ever-present on the Digital Giza site. An aim of the Giza Project is to enable users to use still media at the maximum possible resolution that

we can make available. So, an exemplary image viewer is a must, one with seamless zooming to allow inspection of the kinds of fine detail that a viewer could achieve in the presence of the actual resource. Our previous Giza Archives Project website employed Zoomify (Zoomify, Inc., <http://www.zoomify.com/>) as its embedded viewer. At the time of implementation Zoomify was a favorable solution, though it proved later to be somewhat slow in keeping up with advances in web technology. It has recently made a jump to HTML5 support and other key compatibilities, and we will give it a second look. Another very promising viewer for both its simplicity of implementation (coded entirely in JavaScript) and simple but very effective user interface is OpenSeaDragon (<https://openseadragon.github.io/>). A final option, Mirador (<http://projectmirador.org/>), is the most robust viewer under consideration. This easily-implemented API is the product of collaboration between Stanford University and Harvard University (including lead developer Rashmi Singhal, a member of our Production Team). Although, if selected during the prototyping period as Digital Giza's image viewer, it would be rolled out simply as a viewer, Mirador could easily be reconfigured at a later date to add specialized interfaces such as a book-reader or comparative workspace in which multiple images (from Digital Giza and other sites) could be compared and analyzed alongside each other. For a first launch of Digital Giza, we prefer to keep viewing options simple and straightforward; however, we also recognize the benefits of preemptive preparation for future expansions.

Web Hosting: The Digital Giza Prototype and all Giza Project data will be housed on servers managed by Harvard Research Computing in the short term. As a future full site prepares to go live, we will determine if (as is likely) a cloud-based model is most practical. If so, we would expect to use Amazon Web Services (AWS, <http://aws.amazon.com/>). AWS is extremely affordable, dependable, and very easily scalable—with the advantage of low costs proportional to scale.

UGC: Digital Giza will not involve user-generated content, strictly speaking. Site visitors will have the ability to save and organize media files internally, but not the ability to manipulate or annotate them. By downloading or sharing via social media, however, they will gain the opportunity to do both. At that point users' treatment of media is governed externally by fair use regulations and practices, as well as the policies of individual social networking sites.

CMS: Current expectations for Digital Giza's content management system are based on the architecture and interoperability of the APIs and software solutions described above. Most site content will funnel through APIs, with content updates/additions to database holdings and newly-created 3D media being added through daily API refreshes that draw from the Giza Project server(s). For front-end content on the Digital Giza site—e.g., rotating spotlight objects, blog posts, etc.—a simple (likely web-based) CMS-interface for site administrators (i.e., Giza Project staff) will be developed in tandem with overall site construction. Decisions about use of ready-made open-source solutions (e.g., Drupal, <https://www.drupal.org/>) versus a custom interface will be determined in close consultation with our designers and coders.

4) Sustainability Plan

How will these 3D models hold up over time? How can we create an API that will continue to incorporate both the narrative and the interactive portions of our web offerings? As the Giza Project's primary public outlet going forward, the perpetuation of the Digital Giza web resource is our paramount objective. Technology, online or otherwise, is fast-moving. Our extensibility solutions begin with using common data standards wherever possible, and remaining open to both proprietary and open-source platforms. Our objective is a sustainable environment that works, rather than slavish adherence to a single platform or company. For example, even though our collections management TMS database (GizaCARD) is proprietary, it is nevertheless SQL-based, thus rooted in a standard database language. We are ready to export our data tables from TMS to a platform other than JSON as soon as we confirm that it better suits our needs (though this is unlikely for quite a long time), or to plug in more coherently to the larger archaeological world online. Our selections of potential technical solutions described above are advanced as among the most "future-proof" of options. The use of a data-interchange API in JSON format is a

major case in point. Should web standards move well past HTML5 in the semi-distant future, JSON's flexibilities will enable rapid prototyping of new website formats. Additionally, as new uses for Giza data are conceived, this JSON API will be open to easy experimentation for many lines of computational analysis, exposure to federated searches, and creative data exploration. Other collections could easily be incorporated into the database and, conversely, data is exportable to other systems. Far from an isolated data silo, our results are extensible for other archaeological projects within Egyptology, world history and beyond. For example, Open Context (<http://opencontext.org>) or the Aegaron Project ("Ancient Egyptian Architecture Online," <http://dai.aegaron.ucla.edu>) might represent viable outlets for sharing our data beyond our own Giza website.

TMS supported the original Giza Archives Project website at the Museum of Fine Arts, Boston, and has been chosen by almost all Harvard museums as well. We thus have built-in, University-wide support in place for this collections management software with the accompanying assurance that, should tides turn in the distant future and a new platform be favored, systematic institutional migration of database records and hosted content would follow. Likewise, the use of the open-source standard Unity platform and Web Viewer for 3D-graphic content brings several advantages for sustainability. It ensures the longest possible run for the Digital Giza's 3D-graphic elements, widespread distribution of updates and upgrade protocols as the Unity game engine and web browsers evolve, and the rapid development of graphic conversion processes if/when Unity is surpassed as the leading option for these types of media. Although Digital Giza will be mobile-ready, the immersive use of the Virtual Giza models is not yet feasible on mobile platforms. As mobile technologies advance to better support the demands of real-time 3D content, the Giza Project plans to adjust Digital Giza accordingly, and the Unity platform is certain to be part of this move. Looking to the future of content creation, our use of this most common modeling format lays necessary groundwork for pursuing crowdsourcing of new model assets as graphic modelling and 3D-scanning become ever more mainstream.

Data Integrity: All data are permanent, archived holdings of the Giza Project. Harvard University Faculty of Arts & Sciences Research Computing (RC) remains current in applying best policy standards of file storage and backup infrastructure (including both onsite and offsite redundant back-up), updating and expanding when required. Its primary role in all sectors of Faculty of Arts & Sciences research ensures long-term preservation of the Project's holdings and institutional stability if chosen as the webhosting venue in the long-term.

Estimated costs: If pay services such as Amazon Web Services or professional/custom versions of some open-source APIs eventually prove necessary, most are low-cost, high-function services with costs that ranging in hundreds of dollars as opposed to thousands. As fiscal items, then, these fall under the category of small-scale maintenance costs that can be budgeted as annual overhead. Accommodating them thus falls under the Giza Project's ongoing fundraising activities, which include grants, private philanthropy, and perhaps eventually turning to the tech sector as our development of content for mobile-VR peripheral hardware continues. Applications under development may have some revenue-generating potential. Additionally, availability of internal Harvard student participation with the Giza Project will help will keep broader work going at a relatively cost-effective pace. Comprehensive overhauls of Digital Giza would, of course, require substantial funds on the scale attainable mainly through grants or significant private/corporate funding, both of which will continue to be options for the Giza Project.