# MANAGING CULTURAL HERITAGE in the DIGITAL AGE: Research Policy Document on the Development of Virtual…

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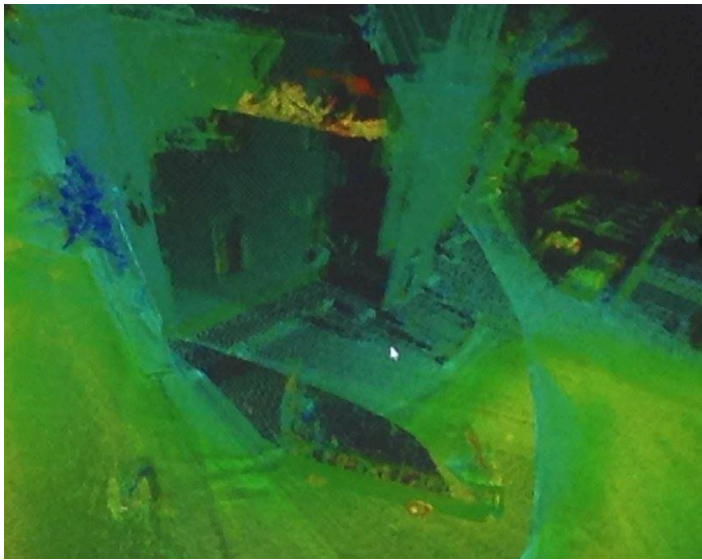Some of the authors of this publication are also working on these related projects:

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# MANAGING CULTURAL HERITAGE in the DIGITAL AGE

# Research Policy Document on the Development of Virtual Heritage for Egypt and the Middle East

## 1.0 EXCUTIVE SUMMARY

The Research Policy Document, "Managing Cultural Heritage in the Digital Age", offers an insight on how a "Research Policy Document on the Development of Virtual Heritage for Egypt and the Middle East" could set out the practice guidelines, as well as legal and ethical framework of governance of Virtual and digital heritage in Egypt and the Middle East. It is designed to inform government policy, new direction of research innovations as well as new legislative and regulations that would not only regulate such fluid fields of creative productions, but also to offer help and support to those who are unsure about their rights, responsibilities and commitments. In its advisory scope, it proposes and suggests systems of communications, legislations and ethical code of conduct that enhance in a structured manner, a better collaborative environments based on shared interest for the creative and innovative field of virtual heritage in the region.

This Policy Paper has been structured to develop necessary frameworks and action plan to regulate, administer the govern such fluid relationship between main stakeholders involved in the collaborations and co-production of digital and virtual preservation of cultural and built heritage assets (tangible and intangible); national institutions' authority and ownership of heritage and historic assets from one side, and private enterprise that energize and develop creative and economic applications with market and business values from another. It has covered such inter-related relationships, highlighting areas of collaborative efforts, necessary partnerships, investments, trainings and market studies, but also warned against concerns and worries of inadequate and abuse of access to heritage material, content and sites without clarity on rights and responsibilities.

Hence, its findings and recommendations could be summarised in the following points:

- Archaeological and cultural heritage are valuable and indispensable assets of societies that play significant roles in the future of those societies. They should be given serious consideration not only on the cultural front, but also in creating a socio-economic and sustainable vision of societies.

- Digital technologies and virtual heritage applications have the potentials for saving endangered and vulnerable heritage sites through early stage detection and analysis of structural failures.

- Virtual Heritage encompasses a wide spectrum of technologies that involve a wide range of equipment, instruments, software and tools. Their applications range from survey, recording and visualization such as VR/AR to remote non-intrusive sensing, high sensitive imaging, and inspection of paintings in exhibitions, museums and galleries.

- Tech companies are advancing technologies that will in no time be able to alienate governmental restrictions on documentation, recording and reproduction of heritage. Hence, a progressive approach towards engaging with and understanding virtual and digital heritage applications is needed to allow appropriate regulation.

- Restriction and prevention is not a viable policy for dealing with heritage management and protection in the digital age. New technologies are developed that compromise any security restrictions that prevent engaging with heritage sites.

- Reproduction of heritage through digital and virtual forms raises certain ethical, moral and legal concerns. These concerns require further collaborations from professionals and researchers in different fields of inquiry.

In its response to the current challenges, difficulties and concerns, this policy document offered a detailed accounts of legislative frameworks, Management strategies, governance structures and action place for a period of Five-years to help shape a new environment of collaboration on the sustained management of cultural heritage in the digital age.

This Document is published for Consultation as this stage. Once Consultation phase of 6 months has elapsed, commentaries, feedback and amendments will be introduced. The Final Version of the Policy Document will be published during January 2018 and will be submitted in its formal version to the Egyptian and other Middle Eastern governments for consideration to inform their national policies.

To register your feedback and commentary on the content of this Policy Document, please do contact us on the following e-mail: heritage@ntu.ac.uk, under the heading: "Feedback on Virtual Heritage Policy Document"

## 2.0 INTRODUCTION

Archaeological, architectural and cultural heritage covers large parts of Egypt and spans an extensive history that ranges from prehistoric, pharaonic, Greco-Roman, Coptic, Islamic, Medieval to neoclassical European in the late Nineteenth Century. Each type of heritage, physical, tangible or intangible, has different characteristics that require unique knowledge, techniques and methodology. Many of these invaluable sites are either inaccessible, endangered or have a huge amount of information that is hardly captured during a short visit, or study. The limitation of physical in-person contacts with heritage, difficulties of travel, risks and rising budgets, left many of those sites either abandoned or hardly visited. Equally, archaeologists, students and teachers alike, are challenged with the enormous amount of information, remote and inaccessible site locations and limited opportunities to engage with the general public, tourists, visitors.

Cultural heritage sites in Historic Cairo, in particular, have been subject to several UNESCO and UNDP revitalisation projects over the past three decades. Sites such as Wekalit el Ghoury, Sabil el Slehdar, Sultan Hassan Madrasa have been adapted for reuse as cultural venues, for events and other purposes. Houses of notable architects such as Gamalia-based Hassan Fathy and Ali Labib Gabr have been rehabilitated as either museums or cultural galleries. But problems facing heritage buildings in Cairo extend far beyond saving or restoring them. It is not only necessary to understand the city as a dynamic process, but to understand the socio-cultural layers of the people. Conservation also includes improving and upgrading people's lives in historic areas as a whole, and heritage buildings specifically.

Due to the context and location of the historical sites, they witness different environmental challenges that affect their sustainable existence. Many of these buildings are in areas vulnerable to unregulated additions, demolitions or construction in old quarters due to private ownership, limited access, or low-income communities who have difficulties in earning a living wage. As a result, several monuments have been damaged, collapsed, become derelict or lost some of their distinctive features, resulting in partial or total obscuring of their authentic identity as representative of the distinctive character of their historic era.

Faced with these challenges, archaeologists in Egypt started to look at Digital Heritage technologies, systems and applications as a parallel route to enable better and broader access to remote, inaccessible heritage sites in the country. Virtual Heritage in this context aims to reconstruct ancient heritage sites, cultural practices and environments in a digital format that will allow people to gain as close a living experience to the past as possible. Virtual heritage and cultural heritage, in this sense, have different, yet interconnected, meanings. While cultural

heritage refers to sites, monuments, buildings and objects with historical, aesthetic, archaeological, scientific, ethnological or anthropological value in real-time and physical contexts, virtual heritage refers to instances of these within a technological domain, usually involving computer visualization of artefacts or Virtual Reality environments. Augmented reality (AR), on the other hand, is a live direct or indirect view of a physical, real-world environment whose elements are augmented (or supplemented) by computer-generated sensory input such as sound, video, graphics or GPS data. It is related to a more general concept called mediated reality.

With the use of virtual and augmented reality becoming the norm in everyday life, the availability and cheap price of mobile apps that engage people with historic context have made it a viable resource to transfer heritage and historic information to the fact growing economy and cultural domain of cloud and online environments. As the use of these systems and applications on professional marketable levels requires vast infrastructure, knowledge and investment, the application of digital and virtual heritage systems and methodologies in Egypt, remains largely experimental and at an embryonic stage.

On the other hand, legal and technical frameworks that govern the management of digital heritage are crucial to prevent manipulation or intentional alteration of digital heritage as well as to deal with the reproduction of national heritage in digital and virtual formats. These would ensure that the 'content, functionality of files and documentation be maintained to the extent necessary to secure an authentic record'. A key aspect of these frameworks is the manner in which national preservation policies define and set guidelines on how digital and legal deposit in libraries, archives, museums and other public repositories should embrace the digital heritage.

In line with their responsibility for the preservation of digital heritage on the national level, governments need to designate national agencies to coordinate responsibilities for the preservation of digital heritage that normally extend to various public and private sector institutions, organisations and stakeholders. In most cases, ownership, responsibility and rights are shared amongst several groups and registries. Accordingly, the sharing of tasks and responsibilities may be based on regulations, legislations and expertise involved in existing systems, laws and activities. In particular, the role of private organisations as hardware and software developers, creators, publishers, producers and distributors of digital materials is important to support and facilitate public institutions such as national libraries, archives, and museums. Collaborations may include also public and private universities that could provide training and research, knowledge exchange with relevant professional associations.

In this context and based on extensive research effort, The Research Policy Document, "Managing Cultural Heritage in the Digital Age", offers an insight on how a "Research Policy Document on the Development of Virtual Heritage for Egypt and the Middle East" could set out the practice guidelines, as well as legal and ethical framework of governance of Virtual and digital heritage in Egypt and the Middle East. It is designed to inform government policy, new direction of research innovations as well as new legislative and regulations that would not only regulate such fluid fields of creative productions, but also to offer help and support to those who are unsure about their rights, responsibilities and commitments.

## 3.0 GOALS

The aim of this policy document is to offer guidance and inform the formal public policies of the Egyptian as well as Middle Eastern governments in their efforts to support, manage and govern the currently ill-regulated virtual Heritage Production in the region. It envisages to reinforce the key aspects of the Virtual Heritage Creative Sector and Industry by emphasising better and more consistent processes and highlighting examples of good practice. Good planning for the management of virtual and digital heritage industry requires policies, comprehensive understanding of difficulties, obstacles as well as opportunities and possibilities. This Document aims to accompany and support a Virtual Heritage Research Policy Document, (Referred to hereafter as Policy Document), to offer examples of well-developed and well-defined projects with credible and tangible outcomes. The VH Policy Document is the principal strategic planning and visionary instrument for the Egyptian Statuary bodies, such as the State Ministry of Antiquities, to set out a balanced understanding, vision and strategies at the local, national and regional level.

"Managing Cultural Heritage in the Digital Age" Policy document provides the frameworks to support flexible yet sustainable development of the practical applications of Virtual and Digital Heritage that balances both public and private interests, considerations, and business objectives. As Heritage, both tangible and intangible, is of collective importance and public interest, whilst technology, knowledge and investments are of private interest, this policy document sets strategy of integration that looks at how private-public partnerships are essential for the management of such an emerging sector that is based almost entirely on the fluidity of online and cloud-based environments, markets and audience. Management and engagement with these practices on the local and regional level are critical to its sustainability and long-term profit-making, while minimising the potential adverse effects of risks of illegal handling of heritage's authenticity, intellectual property rights, non-certified trade.

The Policy Document is the result, amongst others, of a 14-month period of comprehensive investigation, survey and collaborative events that produced informative, innovative and creative solutions and platforms for Virtual Heritage. In doing so, the research team has undertaken a comprehensive research on a variety of digital media uses for cultural heritage over the past 20 years. Those were filtered according to technology used, aspects of excellence and their relevant contexts.

In summary, this Research Policy seeks to draw the outlines of effective strategy for the management and development of Virtual Heritage for Egypt. It aims to:

a) lead progressive approach and foresight capabilities, utilising actions research and policy coordination, to identify critical gaps, potential risks that threated the protection of cultural and built heritage in the digital and virtual domains.

b) provide a critical analysis to governance structure and regulatory frameworks for the acquisition, recording and the reproduction of cultural and material heritage in virtual environments.

c) support the development of a common action framework for the Middle East to reduce vulnerability of cultural heritage through systematic digitization of historic monuments and cultural content in accessible public records and databases.

d) promote intellectual and technical rigor in Virtual Heritage platforms and environments.

e) enable Virtual Heritage documentation, processes and platforms to be integral part of the study, interpretation and management of cultural heritage assets.

f) influence the growth of specialized networks between research centers, creative industries and technology provides that allow to exchange information on national and regional programs.

g) develop high quality and interdisciplinary research aimed at addressing the challenges of digital and virtual heritage management systems, as well as to encourage better collaboration between public and private sectors.

# 4.0 CONTEXT

The advancement of the virtual world has pervaded everyday life through multidisciplinary applications that are used in areas such as simulation for education, entertainment, medical applications, online communications, social media and gaming. Many virtual heritage projects focus on the tangible aspects of cultural heritage, for example, 3D modelling may be created automatically or manually. The manual modelling process of preparing geometric data for 3D computer graphics is similar to plastic arts such as sculpting, graphics and animation or CGI animation. In doing so they often overlook the intangible aspects of cultural heritage associated with objects and sites, such as stories, performances and dances. The tangible aspects of cultural heritage are not inseparable from the intangible and one method for combining both is the use of virtual heritage applications, which applies virtual reality to preserve, protect and present cultural heritage artefacts, sites, and environments.

The use of computer and digital applications for the preservation of heritage has as long history as computer science itself. Since the 1990s evolution of digital modelling, graphics, visualisation platforms and virtual environments have driven the development of new theoretical and empirical methods to approach the problems of archaeology and heritage preservations. Virtual Archaeology, in this context, has become a primary discipline in the analysis of the procedures of management, interpretation and representation of archaeological evidence using 3D computer graphic techniques. Its breakthrough in the digital reconstruction of historic events, lost structures or disappeared heritage enabled both theoretic and applied research to test different propositions, narratives and undertake forensic examination and analysis of archaeological remnants of the past.

However vastly developed over almost half a century, Virtual Archaeology (VA) remained a specialised platform for researchers and archaeologists for research-led activities. The public was not involved in its applications, and nor were its outputs intended for public consumption and use. More recently, the development of new communicative approaches to heritage, history and archaeological contents have progressed the use of interactive strategies that benefit broader groups of beneficiaries, stakeholders and public users. The proliferation of the use of 3D modelling techniques, nonintrusive imaging, geophysics and augmented reality cameras has offered a multiplicity of platforms to simply store, archive and communicate vast amounts of information on cultural heritage sites, traditions and contents. There was a simultaneous necessity to experience new sustainable ways to record, store, archive and analyse ever

expansive records of datasets and to create the best medium to communicate digital systems of preservation.

Cultural institutions, on the other hand, are immersed in connecting with aspects of history and tradition. Their prime purpose is to bridge time, space and experience between the past and the contemporary audience and visitors. Technology offers new frontiers that help widen both platforms of engagement and number or type of regular audience. In a recent article in the Guardian newspaper, Mia Ridge and Danny Birchall (2015) suggested that while people may no longer be missing out on all that cultural heritage has to offer online because of their lack of internet access, there may be a new "digital divide" focused on social media platforms of display. Museums and exhibition managers are therefore contemplating whether the contemporary technology-hungry younger generation, or "digital natives", are receiving appropriate content.

Digital displays and virtual tours have become an increasingly core element of museums' strategy as cultural institutions face up to the challenge of bridging the gap between their capacity with technology and their aspirations to enhance audience engagement with collections. (Ridge & Birchall 2015) To achieve that, they very often make alliances with areas of digital expertise in the large and creative tech industry. There are several projects that explore culturally heritage sites and objects using digital means. For instance, museums are investigating the possibilities offered by 3D printers to examine their collections in a form where detail can be magnified and destruction is far less consequential. The Neues Museum in Berlin has, for example, collaborated with CultLab to scan and develop a Virtual Model of the Nefertiti Bust to enable a larger group of audience to visualise the details of the masterpiece without exposing the invaluable artefact to damage.

Drones, 3D printing and augmented reality apps have become common tools used to construct "virtual museum" experiences for real and digital visitors. Digital and virtual technologies open up new possibilities for exhibitors, archaeologists, architects and curators; they also provoke much debate in museums and user groups over real versus virtual users and the priority for investment. This instigates essential debates around the issues of authenticity, ownership and value, among conventional and advocate archaeologists (Kidd, 2015.) There are currently a number of projects under way that explore how historically or culturally significant sites and objects can be presented using digital means.

The networks of virtual museums are expanding with environments where immersive 3D story worlds become a genuine possibility for historical encounters with heritage sites, either existent or disappeared. The Neues Museum, the Louvre, Victoria & Albert all offer online Virtual Tours curated for public audiences and children (Kidd, 2015.) Virtual Heritage applications for children are particularly important. Many cultural institutions, galleries and museums have developed augmented reality games that help children engage with historic sites or heritage stories through treasure hunts or collections of artefacts. It is not uncommon to find museums rendered in Minecraft, built by an invisible crowd of tech-savvy fans, as in the British Museum's Museumcraft, or Tatecraft (ibid.). In this discourse, the rhetoric of authenticity has been debated and contested as opposed to originality. Authenticity has traditionally been key to the way museum experiences are packaged and displayed to the public users. But as history itself has become subjective, so have notions and concepts such as originality and "authenticity", as they need an authority to justify the evidence behind its identification. The history and authenticity of an artefact is no longer absolute. Its meaning is relative to the audience as it was to its creator.

But these developments have been evolving over decades. People have been talking about virtual museums for many years as ways of allowing visitors access to sites and experiences

that would never otherwise be accessible. What is remarkable is how far we have come to offer realistic interactivity with historic environments, and the way in which the boundaries between virtual and physical experiences have begun to blur. Being able to test new forms of reality that no longer exist raises intriguing aspects of re-reading and reinterpreting history in the eyes of the audience, rather than the curator. Living the experience in the past is different from just watching still objects and images. Objects, images never exited out of context. For example, a Mummy never existed in daylight, nor the setting in which pharaonic artefacts were mostly discovered. Watching them in the tombs of Luxor or in Giza Pyramids has made them entirely more fearful than they are in the museums. Hence, virtual models of pharaonic tombs have been created to translate this experience to the virtual visitor in a way the normal museum could never offer.

DRAFT FOR CONSULTATION

VIRTUAL HERITAGE CAIRO PROJECT

www.virtualheritagecairo.com

# 5.0   TERMS of REFERENCE

When it comes to building virtual environments for historic sites, research and evidence weigh a lot more than the imaginative practices of futuristic creation. For example, to build a single historic monument in a virtual environment, a vast amount of research, archival survey, digital survey, analysis, and socio-cultural history must be undertaken and used. The mass of written, visual, and physical survey records, sources and material used to analyse and recreate the Acropolis is daunting and includes numerous ancient inscriptions, ancient descriptions, two centuries' worth of excavation data, and travellers' paintings, engravings, and sketches of the monuments. During model building, accuracy of drawings requires frequent adjustments, refinements, testing and verifications. More importantly, decisions need to be made that have some subjectivity, as normally historic evidence leaves loopholes and gaps that need to be filled to communicate complete narratives/ descriptions. Thus, building and engaging with the past in 3D, in effect, forced a coherent process of deep research and inherent procedures of self-correction in the interpretation of fragmented evidence and dramatically altered our impression of classical Athens.

During the twenty-first century, the number of virtual heritage firms, industries and innovations has increased substantially, benefiting from large sums of investments in Gaming Culture and interest in both hardware and software that enable humans to engage with virtual worlds (Denard and Baker 2012). Recent technological advances into virtual heritage also include the use of projection holography, laser-plasma virtual displays, and artificial intelligence-based interactive avatars (Sanders ibid.). 3Point Cloud, supporting software and databases linked to virtual worlds have become mainstream environments for several applications and technological solutions. Virtual environments that are constructed to communicate architectural, archaeological and even medical information are now easier to build and navigate, and an emphasis on lighting, vegetation, and character development makes worlds more engaging. Viewing the past in virtual environments that simulate the point of view of the original inhabitants will allow researchers to ask new questions, interpret, and test arguments about the narratives of the past and different ways to interpret evidence. Moreover, researchers and museums have realised the potentials of 3D scanning, modelling and rendering as the best way to archive their acquisitions and stored items that halls can neither accommodate nor display.

Virtual Heritage nowadays has become one of the most active features in allowing users to connect with heritage around the world. Much of efforts nowadays is targeting how to allow users to interact with this technology more than being a static virtual model through adding social, cultural and economic layers. Digitization of heritage through modern multimedia and exhibition technologies such as: virtual reality, augmented reality, mixed reality, documentation,

films, cinemas, games, mobile app., has become central for the preservation of national identity and an effective tool in national strategies.

Compared to traditional conservation of tangible cultural heritage, digital recording of cultural heritage matters is a new form of preservation, typical to the digital society. Museums, archives, libraries, and galleries are extending their operations by creating digital collections of cultural heritage material, such as paintings, books, music, and movies. Even sculptures, monuments, buildings, and whole sites have been scanned and transformed into digital 3D versions (Tonta, 2008). These are made viewable in so called digital libraries, utilising the type of search and browse interaction typical to library databases. Not only does this digital recreation of cultural heritage help to preserve it, but it also significantly increases its accessibility (Tonta, 2008). The public presentation of digitalized cultural heritage matters is further expanded by the relatively new field called virtual heritage.

Many virtual heritage applications do not offer the users creative ways to interact with the presented material; those that do generally merely allow the users to use spatial navigation to tour through a virtual environment (Roussou, 2006). However, even the tours are sometimes limited to interaction both decided and executed by the staff of the organisation providing the application (Economou and Pujol Tost, 2009). Some researchers and practitioners in the field of virtual heritage agree that this is far from optimal, that the degree of interactivity allowed for the public is too low and offers too little variation (e.g. Champion, 2002; Flynn, 2007). The visual features involve, for instance, 3D models, textures and shades. The behavioural involves, for instance, animation, artificial intelligence, crowd simulation and physics. According to Ch'ng (2009, p.465) "In VH [Virtual Heritage], a living entity must in the least have life, appear to be living, or possess the simplest intelligence that enables it to make uncomplicated decisions. In this case, virtual birds that flock together and flee from threats can be considered living, so is a real-time virtual character that accomplishes certain tasks in his/her task environment."

***What is Virtual Heritage?*** We cannot truly hope to understand the complexities of the distant past without testing our theories in an environment that mimics that distant past as closely as possible. It is the only way to ensure that our interpretations are as accurate as the evidence allows. Heritage is a broad term that refers to the study of human activities not only through the discovery and recovery of physical evidence like remains, archival material or objects, but also through studying and understanding cultural evidence, narratives, traditions, art, amongst other human productions. The validity of such evidence relies on two critical aspects: authenticity and accuracy. The representation of heritage activity or historic evidence requires both the validity of information (evidence) and its accuracy to determine whether the representation is as valid and close to reality as possible (Roussou, 2002). To virtualise heritage means to reconstruct it using computer graphics technology into a digital format that enables ordinary users to visual it into a real context and enliven its experience.

Virtual Reality (VR) has been the main driver behind the technology used for virtual heritage. It is defined as 'interactive, self-directed, real-time navigation through a computer-generated 3D space displaying a simulated synthetic scene'. The user is in control of navigating through the spaces at will. Virtual heritage, then, is the use of virtual reality technologies for the visualization and study of the past. Virtual reality for cultural heritage has been used successfully for excavation documentation, data analysis, teaching, publication, museum display, serious games, and tourism. The Definition of Virtual Heritage has moved a lot from the initial concept of Virtual Archaeology, which refers "to the use of three dimensional computer models of ancient buildings and artefacts visualized through digital interface technologies that offer some degree

of immersion and interaction with the content" (Roussou, ibid.). Virtual heritage involves the recording, documenting, synthesis, conservation, reconstruction, representation, digital reprocessing, and display with the use of advanced imaging technology, be it virtual reality, augmented reality or other methods. The development of Virtual Reality systems and Gaming industry in particular has matured enough to impact the evolution of significant research and practice fields that impact our understanding and interaction with heritage. Digital tools and techniques are emerging from academic, government, industry Research Centres to create interactive games, educational and learning programmes that engage children, researchers and the public with heritage.

The use of virtual reality for heritage has been developing to a great extent in recent years. Virtual Heritage is no longer about using photographs and drawings as the basis for building a virtual reality model of the historic monument as it was found and as it may have originally looked, but also to devise new tools for manipulating our digital reconstruction so researchers could compare various iterations with known representations of similar contexts, buildings and structures. Virtual Heritage models produce online, digital supplements that include an interactive 3D reconstruction allowing users to move and change various aspects of the virtual model, a satellite image module, and a complete high-resolution image catalogue of all the pieces. Interactive 3D models can provide global access to delicate and distant objects, enabling more efficient and effective analyses and new types of hybrid publications.

Historians often hypothesize about objects and scenes depicted on wall decorations or ancient pottery vessels. However, correctly interpreting imagery can be the key to successfully interpreting the past, matching pictorial evidence to details found amidst archaeological assemblages or architectural configurations, and intuiting historical nuances lacking from excavations. Difficulties can arise when this analytical process tries to compare 2D graphics to actual 3D environments, actions, or artefacts. Carefully converting what is seen in 2D art to 3D digital models, then, would seem to allow more detailed comparisons and thus more accurate conclusions.

*The discipline of virtual heritage has established itself as the best solution to:*
- *test the validity of archaeological assumptions;*
- *test spatial, behavioural, and temporal hypotheses;*
- *test the accuracy of past interpretations;*
- *assemble globally dispersed artefacts back into a simulation of their original contexts;*
- *visualize intricate change and development; and*
- *absorb complex datasets about the past in 3D, as we do in real life.*

Given the rapid pace of change in computer, mobile and software technologies, what may seem far-fetched and unimaginative possibilities, today, could be outdated in a few years' time. We already have location-aware smart eyeglasses with embedded computers and high-resolution cameras. Link that system to a 3D-based semantic Internet with the capability of projecting holographic images of your REVEAL-created virtual reality models (as will be described in greater detail later) and the result is your very own personal virtual time machine. Please use it wisely.

The increasing development of VR technologies, interfaces, interaction techniques and devices has greatly improved the efficacy and usability of VR, providing more modes of interaction and motivational elements (Addison 2000). This has helped institutions of informal

education, such as museums, media research and cultural centres to embrace advanced virtual technologies and support their transaction from the research laboratory to the public realm. With gaming industry being a catalyst industry, the increasing development of VR technologies has matured enough to expand research from the military and scientific visualization realm into more multidisciplinary areas, such as education, heritage and entertainment.

The use of immersive virtual reality (VR) systems in museums is growing, with larger sections being dedicated to virtual display of cultural heritage and immersive augmented reality, as effective and interactive technologies that have inevitably impacted the education of children in traditional sciences, history and arts. In the present day, new media and digital tools offer us the possibility to experience virtually reconstructed historic sites or virtual heritage sites as visitors, travellers or even as residents. Although virtual heritage poses great potential to reconstruct our past and memory, many critics have identified different issues that often inhibit widespread distribution and use of virtual heritage. They blame high cost, sophisticated hard and software, inaccessibility of technology and training, or complexity in usability and high maintenance prohibiting widespread dissemination, distribution and use of virtual heritage media.

Digitization of heritage through customs, photo archives, film footage, oral history documentaries and buildings has become central for the preservation of national identity and an effective tool in national strategies of undermining radical ideologies in marginalized communities. The use of online platforms, virtual exhibitions and digitization of heritage is ever increasing and the virtual reality models of historic sites are becoming a main tool to engage with distant and remote heritage locations, whilst stretching audience outreach and contributing to online income generating activities. Yet, digital and VR models remain digital replicas of physical structure and static reality that lacks essential aspects of socio-cultural life, cultural traditions and rituals of everyday life that justify and rationalise the use of space and structure to the unfamiliar viewers. Inspired by Game-design architecture and technologies, new generations of augmented realty platforms started to incorporate live-feed social data and information of cultural aspects of the built environment.

In Egypt, however, the production of VR and digital models of historic sites is still at an early stage and lacks sets of skills, appropriate digital platforms and technical skills. With few examples of VR models produced for the physical forms of Ancient Egyptian artefacts and monuments, much of complex environments and built fabric of the medieval city has remained peripheral and largely uncharted territory. As much of local traditions, memories and cultural practices and rituals emerged from the enduring communities and markets of Medieval Cairo's historic sites and Hawari (alleyways) communities (Abdelmonem 2016), virtual reality models of the old city pose unique challenges for new technologies of digital modelling. The medieval fabric and buildings of the conservation area of Islamic Cairo would benefit from culturally-fed Virtual Reality models that incorporate daily habits, modes of interaction and traditions. These have been frequently photographed, filmed and recorded in drama series and cinema productions. Digital heritage models in this sense offer real cultural experience of heritage in original settings that bring historic experience to life in the present.

The Virtual Heritage Cairo Best Practice Manual engages with possibilities for interactive virtual environments as institutions of informal education to be active tools in developing immersive interactive virtual archaeology and cultural heritage projects for the broad public. This manual would support the establishment of a catalyst for Egyptian Digital Heritage and support technically-able, knowledgeable entrepreneurs and researchers who share the benefit of heritage preservation as active cultural practices.

The projects of virtual heritage serve to illustrate the advantages and exciting new opportunities for archaeology that interactive 3D models can offer. They offer different and novel insights on how Virtual Heritage offers great possibilities for researchers and archaeologists alike. In the first, the project team tried to offer visionary investigation into the temple of Athena Polis, ruined as a result of the Persian sack of the Acropolis in Athens. Most visualizations depicting a reconstruction of the Acropolis from that period leave an empty space where the so-called Old Athena Temple would have stood (Connolly and Dodge 1998: 63). The team used interactive 3D models to test a new hypothesis: whether a damaged Old Athena Temple could have remained standing. The team used a mass of written, visual, and topographic surveys and numerous inscriptions, ancient writers' descriptions, excavation data, paintings, and engravings. The resulting virtual reality model of the Acropolis and accompanying historical evidence confirmed the location of Old Athena Temple and subsequent classical buildings were carefully arranged around its ruins. Seeing the past in 3D forced corrective actions in the interpretation of basic bits of evidence and dramatically altered our impression of classical Athens (Vizin 2017).

As the main stakeholders and beneficiaries of Virtual Heritage, Virtual museums and exhibitions concern themselves with three principles: '*Collect*, *Preserve* and *Display*', but similar to the physical museum, their site is accessible via online access.

*Collect*: Virtual museums cannot handle objects in the way that a physical museum can; collecting does not only refer to physical objects. Museum collections can also contain intangible material, as collection does not necessarily have to be based on physical objects. It is, however, possible to collect information in a more traditional sense of the definition, even in the virtual museum. As will be studied further in Types of virtual exhibition, Interactive exhibitions, the museum could work as a base of collecting where users of the VE would distribute contributions. Through this sort of collecting, the audience could contribute with various types of multimedia to create or increase the collection of the virtual museum.

*Preserve*: There are ways for a virtual museum to create its own born-digital collection. This would be a requirement for any preservation to become involved. Though the virtual born digital collections would not require the same preservation strategies, there would still be a need for some sort of preservation of its material and immaterial content. Even though born-digital material does not exist in any physical form in its original state, preserving ideas has to be put into consideration for the collections to stay available. The problem with digital material is not necessarily one of storage, which is generally a problem in the case of the physical museum. Storage of media is becoming increasingly cost efficient; however, files also tend to grow larger with the introduction of new, and better quality file formats. The main problem with digital collections overall is that of digital heritage.

*Display*: All virtual museums have some way of displaying their content in a virtual environment (VE). This VE constructed for the virtual museum promotes various types of activities, created to engage the user in the theme of the museum (Chen 2007, p207). A vital part of the virtual museum is the accessibility. Not only does this accessibility turn the museum global but it also contributes to a sort of democratization of the museum, making museum collections available to theoretically anyone (Malpas 2007). Putting content online in the shape of databases, virtual museums, personalised exhibitions, etc. not only lets people of various cultures enjoy each other's cultural heritage, but would let cultures that have lost parts of their cultural heritage to other countries get virtual access to it (Fahy 1995).

Virtual museums have provided the unique opportunity for accessibility to Global cultural heritage that is mobile, no longer location based, but rather available to everyone and everywhere. Not only is this an important quality for reaching out to a different and wider range of audience, it also adds a democratic aspect to the way the public engage with virtual museums regardless of their cultural background, affordability and social class. Content is not just available to the audience living in proximity of the physical collections, but becomes a part of the global cultural heritage. For the digitization of conventional 2D exhibits in Egypt, high quality photographs were used. The 3D exhibits' digitization involved one of the following three approaches. The selection of the most suitable approach in the project depended on the exhibit and the requirements set for its presentation.

Digital Scanning of historic manuscripts and displaying them in a virtual library was used by Bibliotheca Alexandria to digitally archive its rich collections of historic texts and manuscripts. Its digital archive is increasing and provides public and democratic access to the global audience interested in the historic manuscripts and historic accounts of Egyptian Medieval and ancient dynasties. 3D photography and photogrammetry is the easiest and most straightforward method of using innovative online games engines and applications to formulate 3D models out of hundreds of photographs of a single object, building and/or site. The object is captured by the camera as a multiple overlaid set of photographs. A three dimensional description of the object including the images mapped on its surfaces is deducted and exported in a format compatible with the VR software packages. Recent developments have provided accurate models that are measurable and could be used for drawings. 3D Laser scanning & Modelling, on the other hand, is used for artefacts and objects where quality and detail of the representation are essential and where surface properties enable laser scanning. This has been used extensively in the Grand Egyptian Museum for its newly digital archive collection, which aims to record and document each archaeological artefact in the virtual log. Those are planned to be used for future virtual museums displays.

Adopting VR/AR technologies poses challenges to museums in terms of efficiently creating 3D models of artefacts, and building virtual exhibitions based on these models. Virtual reality (VR) and augmented reality (AR) technologies offer an ideal presentation medium for museums through the way virtual exhibitions enable different audiences, including the disabled and students of all ages, as well as the general public to access and interact with vast numbers of objects scattered among various localities in an engaging and informative way. In recent years, 3D model creation has become faster, easier to use, and more affordable. Museums operate high quality 3D scanners for archiving their highly valuable artefacts and archaeological objects. However, they will also require efficient, cost-effective, and interactive VR/AR exhibitions based on existing collections of 3D models. In addition, virtual exhibitions must provide museum visitors with an intuitive human-computer interface based on well-known metaphors. Users should be able to interact with digital contents as easily and naturally as they can with real-world objects (Walczak ibid).

In an ideal scenario of a virtual museum tour, the "visitor" is placed in the virtual environment (CAVE or Dark Room) of a 3D heritage site scene with a first-person perspective of the site's terrain, seeing the scene and its monuments as it would be seen in real life. The terrain should be of the highest detail with a high resolution texture. Using the keyboard and/or mouse, the visitor should be able to manipulate the view to create a sense of place and the atmosphere of walking through the scene (flying could also be incorporated). The visitor should then be free to "visit" 3D heritage structures. When arriving at a structure the visitor should be able to view 360 degree photographic panoramas of the environment to add a sense of reality. The visitor would

then be able to explore the 3D model of the structure by entering and walking about. Information panels should pop up giving descriptions of the structure and videos of the structure could also be made available.

To further explore the site, the visitor can move on to further investigate other structures and the landscape. There should be a top-view mini-map window in the corner of the screen to indicate the visitor's present position on the site. On this map there should be objects and infographics, allowing the visitor to move to new points of interest on the site. Layers of various map data should also be incorporated into this top view, allowing the visitor to choose varying combinations of these layers. The goal is to make the tour simple, interesting, informative and attractive, and therefore it must be a "fun and immersive" experience. The data must be enticing enough for the user to explore and learn further. Additionally, video and audio narration should be available.

Preservation of cultural heritage and its display in virtual museums are becoming increasingly digitalized, and as a consequence have become more open to public scrutiny. These displays, however, are struggling to live up to the expectations of the public. They may be ideal in responding to a need for a fashionable synergy between scientific inquiry, technology, art, and everyday life and, consequently, engender more serious cultural demand (Roussou 2008). But, they are still premature in the way they appeal to the general public and how they offer new, engaging and interactive experiences that surpass the engaging experiences with the actual and real objects. Hence, a number of functions are needed to facilitate the synthesis, conservation, reproduction, representation, digital reprocessing and display of VN with the use of advanced VR imaging technologies (ibid). As per Roussou VH is a dialogical relationship between representation (to accurately visualize reconstruct the data), experience (to present and enhance the virtual environment with elements that incorporate knowledge providing and spectacle), and interaction which provides the ability to gain insights by actively engaging in and even modifying the experience.

In order to respond to such demands, some of the virtual heritage applications and projects went further to create fictional scenarios for more engaging experiences. Some of these virtual experiences appeared more successful in video gaming than virtual museums. In one example, the work of the Chinese Room, the Bafta award game development studio, such as Dear Esther and Everybody's gone to the Rapture offer interesting cases in question. The video games offer interesting fictional and engaging scenarios that force the audience to actively control and move within a set of historic and natural contexts to search for clues and understanding. The success of such experiences is not in the physical context as much in the socio-cultural context, engaging stories, sound effects and imagination. In short, the intangible aspects of the VR/VH spatial settings are more effective than the visual representation.

One of the most symbolic buildings illustrated by virtual museum visit is the Louvre Museum in Paris (Louvre 2013). The visit consists of a simple website containing 360 degree photographic panoramas. An overall map allows visitors to find their way in the place and indicates the various available points of view in the visit. The visit also contains links towards internet pages presenting further information on the various works as well as the possibility of seeing certain works in close-up. The virtual tour of Oxford (Oxford, 2004) uses interactive web pages which allow exploration and 360 degree manipulation of photographic panoramas of the city and university, constructed from hundreds of high quality photographs of the city, with a photography tutorial blog about how these panoramas were captured and created (Harrisson 2006). In both cases, world renowned sites and museums have been on display through simple virtual platforms to offer an engaging experience to the ordinary users.

Google foundation's World Wonders Project (WWP Google 2012) offers a virtual exhibition of 130 historic sites in more than 18 countries that it documented within a website providing besides panoramic views, associated information in descriptive index sheets, videos of users and, more rarely, 3D models. By integrating these into its flagship Street View technology, Google has a unique opportunity to make world heritage sites available to users across the globe. The World Wonders Project presents a valuable resource for students and scholars alike. The project offers an innovative way to teach history and geography and is also supported by a website that provides a window to 3D models, YouTube videos and photography of the famous heritage sites. Together with partners including UNESCO, the World Monuments Fund and Cyark, the World Wonders Project is preserving world heritage sites for future generations. Meanwhile, France has a directory of French-speaking archaeology (Archéophile, 2013) which lists a multitude of sites proposing virtual visits, located in particular in France. But equivalents can also be found in numerous other countries.

# 6.0  RATIONALE for Virtual Heritage

*"Cultural Heritage site refers to a locality, natural landscape, settlement area, architectural complex, archaeological site, or standing structure that is recognized and often legally protected as a place of historical and cultural significance"*

*ICOMOS, 2007*

The ICOMOS Ename Charter (ICOMOS, 2007) states that  Cultural Heritage is a valuable asset that should be protected and preserved. Of equal importance to such tangible heritage, intangible heritage has become a significant asset for several societies, cultures and communities, especially those whose cultural traditions and practices are in severe decline or on the verge of extinction. However, while the physical heritage could be recorded and preserved based on its virtues of existence, intangible traditions are obviously more difficult to represent in a virtual environment. With conservation in mind, projects for reusing Cairo's historic buildings are strongly advocated as a reverse process for heritage obsolescence.

In Egypt's case, both tangible and intangible heritage are facing similar risks. Especially since the 2011 Uprising, many medieval heritage and religious sites and monuments have also suffered looting and damage. Mother-of-pearl and ivory inlays were stolen from the minbar of the 15th century Qaitbay Mosque (Cairo). Mamluk copper doorknockers were stolen from the Qagmas al-Ishaqi and Gay al-Yussufi mosques (Cairo), which also date back to the 15th century. There has been a rash of violence against Sufi mosques and shrines, especially in Alexandria, Qalyubia, and North Sinai governorates. The Sheikh Hamid Abu Jarir, Sheikh Zuwaid, and Sheikh Salim al-Sharif Abu Jarir Sufi shrines (North Sinai) were all bombed and suffered varied degrees of structural damage, according to Al-Ahram Newspaper articles (ElAref 2012). Dozens of Coptic churches have also sustained various forms of damage, which includes both looting and intentional destruction. There are plenty of accounts of severe damage to ancient Coptic sites, churches and monasteries, which were set on fire, suffering varying degrees of damage over the past few years and as part of the infrequent but troubling sectarian incidents. The 4th-century St. Kolta church in Ansina was partially damaged by looters who have dynamited the church's walls to search for artefacts.

In light of increasingly difficult economic aspects of conservation, lack of funding and ability of local government to handle the preservation of many historic sites in Egypt and other regional societies, it is fair to assume the sustainability of preservation of all valuable heritage and historic monuments may not be guaranteed. As Middle Eastern societies learnt the hard way, instability, conflicts or civil riots could have everlasting damaging effects on their historic assets and cultural heritage. Hence, documenting each historic layer and heritage traditions associated with historic

structures and their context could be equally important to their physical preservation. Digital documentation may at one point be instrumental in rebuilding destroyed buildings and monumental structures. This could show the difference in culture and social aspects through different eras.

Nowadays, when tourists visit ancient cultural heritage sites, generally, they cannot fully grasp the ancient vibrant life that used to be integrated in the present ancient ruins. Their learning and understanding is quite limited. Considering the changing environmental context and landscape around those sites over centuries and millennia, even the rationale behind their existence would be very obscure. This is particularly true with ruins such as the remnants of ancient cities, where visitors are unable to understand behaviour patterns and social systems of living in ancient Egyptian cities, based on a few archaeological remains. Reconstructing the site using fragments of cultural and social evidence of the period, typology or culture of the time, the use of VR, VH and AR technologies, these remnants would provide the genetic structures of the larger society that could be visibly experienced in real-time animation. (Thalmann et al 2005).

The use of digital and multimedia techniques and methods to create new forms of recording and documenting cultural and archaeological heritage has intensified in recent years (Lepouras et al 2001). Historical streets and archaeological sites in Egypt are unique pieces of art scattered in overcrowded areas or faraway in the desert. This raises the need to have a 3D documentation system and virtual reality reporting of all spatial information for each place, which can be used for monitoring purposes and observing long term changes to those monuments. Using the advantages of 3D documentation and VR at those sites can offer a way to overcome common problems, protect them from losing vanishing identity, at times of political and civic instability.

It must also be stressed that the digital preservation and recording of heritage is not only limited to the professional hi-tech firms, corporations, research organisations, or governments. Community-based productions of multimedia have contributed significantly to the addition of massive big data of imagery and 3D modelling on crowd sourcing sites such as Google Earth. The documenting, transmitting, and revitalising of intangible heritage are significant domains in which local cultural property discourses are articulated and put into practice by individual contributions of ordinary people (Noyes 2006). National and local governments, heritage workers, anthropologists, curators - and increasingly, local stakeholders who represent their own cultures, languages, and heritage - are some of the agents of transformation of intangible cultural expression into digital heritage. All play a role in determining what media documentation enters the public domain, and what remains privately managed at the local level (Noyes *ibid*).

With the history of ancient Egypt being a basic historic study in primary schools around the world, the use of new real-time visualization of its ancient cities and structures will be more attractive to young children and school pupils. The understanding through direct virtual engagement would amount to similar, if not equal experience to visiting the historic sites. Technologies used in reconstructing its past would generate global demand. Adding similar experiences to the vast collections of Ancient Egyptian Artefacts at world museums would provide other global venues of display aimed at both specialist and non-specialist audiences.

# 7.0  VIRTUAL HERITAGE in EGYPT

Archaeological, architectural and cultural heritage covers large parts of Egypt and spans an extensive history that ranges from prehistoric, pharaonic, Greco-Roman, Coptic, Islamic, Medieval to neoclassical European in the late Nineteenth Century. Many of these invaluable sites are either inaccessible, endangered or have a huge amount of information that is hardly captured during a short visit. The limitation of physical in-person contacts with heritage, difficulties of travel, risks and rising budgets, left many of those sites either abandoned or hardly visited. Equally, archaeologists, students and teachers alike, are challenged with the enormous amount of information, remote and inaccessible site locations and limited opportunities to engage with the general public, tourists, visitors.

Cultural heritage sites in Historic Cairo, in particular, have been subject to several UNESCO and UNDP revitalisation projects over the past three decades. Sites such as Wekalit el Ghoury, Sabil el Slehdar, Sultan Hassan Madrasa have been adapted for reuse as cultural venues, for events and other purposes. Houses of notable architects such as Gamalia-based Hassan Fathy and Ali Labib Gabr have been rehabilitated as either museums or cultural galleries. But problems facing heritage buildings in Cairo extend far beyond saving or restoring them. It is not only necessary to understand the city as a dynamic process, but to understand the socio-cultural layers of the people. Conservation also includes improving and upgrading people's lives in historic areas as a whole, and heritage buildings specifically.

Due to the context and location of the historical sites, they witness different environmental challenges that affect their sustainable existence. Many of these buildings are in areas vulnerable to unregulated additions, demolitions or construction in old quarters due to private ownership, limited access, or low-income communities who have difficulties in earning a living wage. As a result, several monuments have been damaged, collapsed, become derelict or lost some of their distinctive features, resulting in partial or total obscuring of their authentic identity as representative of the distinctive character of their historic era.

Faced with these challenges, archaeologists in Egypt started to look at Digital Heritage technologies, systems and applications as a parallel route to enable better and broader access to remote, inaccessible heritage sites in the country. Virtual Heritage in Egypt aims to reconstruct ancient heritage sites, cultural practices and environments in a digital format that will allow people to gain as close a living experience to the past as possible. Virtual heritage and cultural heritage, in this sense, have different, yet interconnected, meanings. While cultural heritage refers to sites, monuments, buildings and objects with historical, aesthetic, archaeological, scientific, ethnological or anthropological value in real-time and physical contexts, virtual heritage refers to instances of these within a technological domain, usually involving computer

visualization of artefacts or Virtual Reality environments. Augmented reality (AR), on the other hand, is a live direct or indirect view of a physical, real-world environment whose elements are augmented (or supplemented) by computer-generated sensory input such as sound, video, graphics or GPS data. It is related to a more general concept called mediated reality.

With the use of virtual and augmented reality becoming the norm in everyday life, the availability and cheap price of mobile apps that engage people with historic context have made it a viable resource to transfer heritage and historic information to economic and cultural domain of cloud and online environments. As the use of these systems and applications on professional marketable levels requires vast infrastructure, knowledge and investment, the application of digital and virtual heritage systems and methodologies in Egypt, remains largely experimental and at an embryonic stage.

This Policy Document for Virtual Heritage in Egypt and the Middle East introduces a comprehensive evidence-based analysis of frameworks and established processes required to regulate, organize, support and manage the evolution of virtual and digital heritage in the region. In the production of this policy document, we used evidence and examples analyzed in other document, laws, best practices in European settings, as well as world leading projects. In building up this Policy document as a framework for Egypt and Middle East Charter for the management and governance of Virtual Heritage, we have utilized over two decades of international efforts, UNESCO charters, resources and research. These included the first Charter on Digital Heritage in 2003 & 2007, "The Digital Heritage as a Common Heritage", and the Vancouver Declaration in 2012. We also consulted and reference London Charter as a common and widely reference taxonomy on the management of the preservation of digital heritage. For better understanding of background research conducted during the production of this document, the reader can consult Virtual Heritage Cairo's Publications; Volume 1, "*Virtual Heritage: Global Perspectives for Creative Modes of Heritage Visualization*", and Volume 2, "*Virtual Heritage Manual: Best Practices Manual for Egypt & Middle East*"

# 8.0    BENEFITS and OPPORTUNITIES

*"Communication is one-way in the sense that the ancients are dead and cannot ask or answer questions, but we can learn about them by interacting with simulations of them and their environments."*
*(Jacobsen and Holden 2007)*

Cultural heritage is becoming an important application for virtual reality technology and heritage documentation. Over the last 10 years, Egypt has been using virtual reality and some technology as an interactive tool to engage visitors through the tour. Although virtual reality has started to gain popularity, the markets in Egypt have not yet managed to provide those tools through their historical monuments. Many organisations, such as UNESCO, CyArck, HIP, etc., have started to help Egypt to preserve some of those monuments. To prevent the loss of archaeological and historical sites, detailed documentation and studies are being carried out by using different tools to get the best resolution and level of details of those sites. Virtual Heritage is a type of simulation that documents our heritage to enable global access. This simulation merges different worlds together from different eras. Computer technology allows the visitor to travel through a virtual world and move through it virtually. Through the VE system, visitors are easily able to view a simulation of important objects, buildings or environments which were constructed a long time ago. The VE system is also a secure way of visiting an environment which may be too difficult or too remote, too dangerous to physically visit. These environments may no longer exist today, may be damaged and in need of reconstruction, or not easily experienced, either because they exist at a remote site or their condition doesn't allow for their interior to be navigated.

Virtual heritage applications use the immersive and interactive qualities of VR and also provide the possibility of visiting places that no longer exist at all, or of viewing how the places would have appeared at different times in history (Pape et al 2000). VH application can increase the accessibility of historical and archaeological sites worldwide and increase visitors' interaction with an exhibit, even if the monument doesn't exist anymore. In addition, it can present a heritage environment that doesn't exist locally, allowing the users to see it from their own places. Therefore, some organisations have started to lead the way to save heritage and monuments across the globe. One such is CyArck, a project that aims to create a 3D digital library by using 3D laser imaging. The database requires the visiting of each historical site and the laser scanning of its monuments. Data is collected and information documented on some sites in Egypt through using digital and multimedia techniques. This has created new forms of

recording and documenting cultural and archaeological heritage in recent years (Lepouras 2001). Additionally, through those monuments awareness has been raised.

On the other side, historical streets and archaeological sites in Egypt are unique pieces of art scattered either in overcrowded areas or faraway in the desert, but always driven by socio-cultural needs. A 3D documentation system and virtual reality are needed to report all spatial information for each place. One benefit of documentation is that it can be used for monitoring purposes and observing the changes that are happening over time to these monuments, thereby preserving a history of those monuments due to changes in the layers through different eras. It also offers a way to protect these sites from losing their identity, if they are reused or destroyed. Additionally, it allows sharing of our social and cultural layers over the ages globally and allows the users to interact with them freely. According to the CyArck mind-set, documentation of each stage and layer over the buildings' life, with its context, will last forever, allowing also for future attempts to revive them.

Cultural heritage experience is increasingly becoming an important output and product of virtual reality technology, digital preservation and heritage documentation. Those applications have different purposes and a diverse range of intended users. For instance, there are applications used by researchers for studying simulations of different conditions, applications used by museums to visit lost historical sites, while others are developed to revive and test the stability of historic building fabric and structures. To achieve their prospected objectives, virtual heritage applications use the immersive and interactive qualities to enable their users or visitors to access computer reconstructions/simulations of historic sites that would normally be inaccessible due to location or fragile condition. In this sense, the cultural heritage is celebrated, engaged with, benefiting from income generation whilst remaining protected and unaffected by the flow of masses of visitors, and, even so, admitting a much broader range of visitors than would normally have access to it. Moreover, they also provide the possibility of visiting places that no longer exist at all, or of viewing the manner in which antiques or monuments appeared in their real or imaginary contexts (Rape et al., 2000).

The field of VH is trying to address the gap between the spatial data produced on heritage sites and the use of the data by interested parties. Resolving this gap will allow users to view combinations of 3D spatial data easily and in an engaging 3D environment (Wessels 2014). Another definition, that of the Virtual Heritage Network (VHN), views VH as not just about cultural information produced on the web, but more about gathering together a virtual heritage, with cultural information which has practical applications, such as how technologies can be useful in preserving, restoring and also reconstructing the heritage (Leite 2005). It deals with technology, art, and everyday life and, consequently, engenders serious cultural demand.

Digital and virtual preservation of a heritage approach can, therefore, increase the accessibility of museums, historical and archaeological sites, to world-wide audiences. It could also allow much larger and more in-depth exhibits than a physical museum and offers visitors greater opportunity for direct interaction with an exhibit, even if the monument doesn't exist anymore. More significantly, these platforms help with the creation of a number of educational and cultural programs targeting audiences on many educational levels. VR/AR techniques, for example, allow virtual journeys through ancient cities that have been damaged or no longer exist, such as Ancient Thebe or the Forbidden City.

Even though the users have the freedom to move freely in virtual environments, navigation models also give them the choice of following a predefined path that makes the experience more meaningful by highlighting points of historic significance. Visitor engagement through educational and decision making tools that can offer interaction with the past has recently been

exploited by video-games creative industries. Such enhancement of the educational experience is achieved through adding interactive tools such as construction ability, where the visitors can switch between elements and compare the evolution of style through the evolution of time in the city. Interactive participants can walk through or fly over accurate three dimensional reconstructions, explore the historic city as it unfolds through time. In such rich history as that of Medieval Cairo, they can experience the life of its historic significance, stylistic architecture, people and socio-cultural customs, habits and way of life.

On the other hand, virtual and digital heritage are subject to inherent challenges and complex debates. The visual representation of the past using digital means is accused of lacking accuracy or superimposing subjective scenarios, as a result of the abstractions and dramatic assumptions of multivariate information that must be adopted in order to adhere to the visual culture of our times. Technologies dealing with the virtual representation of heritage content are, by definition, less concerned with accuracy of the content itself and more involved with the form of the visualized content. Virtual environments have, in this sense, been limited in the ways characters are depicted, and usually follow an anthropomorphic model. A further complication in relation to design and production of a virtual experience is that adding the immersive and interactive features can challenge the border that divides an educational experience of the past from an entertainment endeavour (Roussou, 2008, p268). However, there have been many research efforts to build characters that are believable and realistic and sometimes have stories attached to them to mark them as remarkable and memorable. For Medieval Cairo, the historians' accounts and archival records are so rich with characters, events and social engagement that they could be easily attached to navigation tools for historic buildings and communicate events and incidents that have actually taken place.

But, the preservation of cultural heritage using digital and virtual technologies is by no means an easy task. It is a long term process full of challenges, obstacles and difficulties. There is an obvious lack of multidisciplinary teams who can combine the technological knowledge and advances in developing virtual archaeology, computer modelling, with input from historians, sociologists anthropologists and architects to provide a fully rounded understanding of a single building/site and its associated history and everyday practice. Such long and time-consuming experiences are in most circumstances driven by Research teams at Higher Education Institutions, which are conventionally underfunded. Technology-driven production experts, on the other hand, are more concerned with the quality and accuracy of the visual models and their attractiveness in the market, so they can attracts more projects and income. Coordination of these various interests and resources requires informed and long-term collaborations involving research-led creative industry or practice-led research organisations, in a public-private partnership that is hardly a conventional model in the Egyptian context.

An important aspect is how VH and education are related to present culture in a way that enhances the learning process, encouraging students and researchers through stimulating methods of presentation of archival materials and historical events (Roussou & Efraimoglou, 1999). In times when direct and physical access to heritage sites remains difficult and interrupted by infrequent but serious risks of terrorism, the potential of virtual heritage has become paramount. Virtual Heritage represents an important element of long term strategies for sustainable cultural tourism. With regards to very sensitive heritage sites which have remained inaccessible to the public, such as some of the Pharaonic tombs that cannot cope with visitors' demands or they would have an endangering impact, virtual reconstruction of the site has enabled visitors to experience the original tombs through simulated real-scale views in newly constructed space of similar characteristics (Hobson & Williams, 1995; Arnold, 2005). Moreover,

VH can be a possible solution for significantly decreasing the impact of visitors on destinations (Cheong, 1995), whilst offering non-destructive public access to cultural heritage sites (Refsland at al., 2000). In addition, VH makes it possible to interact with ancient, fragile objects, maybe located far away, that cannot be handled in the real world (Paquet & Viktor, 2005).

> ***Motivations for Virtual Heritage reconstruction:***
>
> - *reconstruct monuments and buildings that no longer or only partially exist;*
> - *interact with precious and fragile objects, without compromising them;*
> - *document existing artefacts for future reconstruction in case of damage;*
> - *present a new educational paradigm;*
> - *provide different points of view of past, present or future historical events;*
> - *provide virtual tourism.*
>
> *(El-Hakim et al., 2004)*

There are several other photomodeling software systems, such as Agisoft Photoscan, Autodesk 123d Catch, PhotoModeler, ARC 3d, and Insight3d, being increasingly used by Archaeologists to embrace the advantages of having interactive 3D visualizations provided to field teams in real time. Excavations mostly now include digital documentation and recording systems utilising point-cloud databases, 3D imaging, and both hand-held and airborne information collection devices (Olson et al. 2013; Addison et al. 2013). One system is REVEAL that "integrates and coordinates all data types (such as photos, drawings, 3D models, and tabular information) with semi-automated tools for documenting sites, trenches, and objects; recording excavation and site-evaluation progress; researching and analysing the collected evidence; and creating virtual worlds". Text is entered onto Web browser-based forms via laptops, tablets, and photographs; records of fieldwork activity can be dropped from the device to the REVEAL Platform including regular or hand-held device digital cameras. Once photos are associated with specific objects/space, the REVEAL photomodeling process through Analyser begins to integrate geo-aligned satellite images, geo-aligned plans, geo-aligned 3D models, photographs, and tabular data inside the program.

The main screen has a context-sensitive information panel and index, and windows that each can display photos, plans, or 3D models. Anyone using the system can compare data across many sites and equally 3D spatial data collected today, yesterday, or months ago. Contexts are viewed and compared interactively in virtual reality simulations of the original features. The system allows for viewing artefact elements and distribution to draw cultural inferences across large sites. Such facilities are no more a luxury, but integrated in both archaeological surveys and historic buildings analysis. (Sanders 2014, Vizin 2016).

# 9.0 ECONOMIC FEASIBILITY

The conventional grant-based funds for virtual heritage are becoming increasingly rare in the current economic climate worldwide, whilst the demand for access to digital heritage is increasing among the general public, professional researchers, universities, and educators in primary and secondary schools. These realities are inspiring new economic funding models for heritage digitisation, virtual preservation and online access. In this sense, Preservation of digital heritage requires evolving technologies, and high standards of operations with the requisite policies and procedures; but critical to delivering the digital and virtual preservation service is perpetual financial sustainability (Enumerate 2015). Digital heritage has significant financial, cultural and scientific value. However, its market and economic value is still at the explorative and embryonic stage.

So far, national government grants for digitisation projects are the leading source for funding, but are always vulnerable to policy changes and austerity and budget cuts. This does not help the perpetual financial stability of a preservation repository. Not-for-profit organisations and public-private partnerships can operate efficiently and receive compensation. These include, but are not limited to, harvesting heritage assets, preserving, making accessible, repurposing for copy-on demand and curated collections, subscription services to closed collections and providing optional premium services for open collections (ibid.) Preservation institutions would need to invest excess revenue in foundations as a long-term financial strategy towards perpetual sustainability.

The eNumerate Digitisation in Cultural Heritage Report 2015 analyses data from over 1000 libraries, archives, museums and other European institutions to paint a comprehensive picture of the current digitisation landscape in Europe. The 2015 Report's survey data reveals 84% of institutions now hold a digital collection of some sort, whether purely digitised material or combined with digital elements. On average 23% of European collections have been digitised, with Museums having the highest proportion (31%), up from 24% in the 2014 survey (eNumerate2015). The number of institutions with a predefined digitisation strategy had risen to 41% in 2015 from 36% in 2014, offering a clear indication of increased focus towards digitisation and creation of digital archives (ibid.)

Even though there has been a rise in investment, funding resources in the cultural heritage sector are still limited. The report suggests that 55% of descriptive metadata is unavailable online for general use. This implies that a large amount of records is virtually unsearchable because the associated metadata is not online. Libraries have 68% of their associated metadata available online for general use, while 51% of records are only available for staff use and 41%

of data is available to archive visitors. With more data made available, the market value would be expected to increase, as would the need for supporting infrastructure and metadata, as part of the digitisation efforts.

Internal and external budgets for digitisation and cultural heritage are made on an annual basis and can be funded by internal budgets and external budgets. On average the costs related to keeping digital collections are quite substantial, summing up to €276,471 (the figure was € 245,000 in 2014). This sum is an estimate of all the costs related to the initial creation, ongoing maintenance, enhancement and preservation of the digital collections. The cost of the staff time devoted to such activities is included in this estimate.

According to Digi-Capital, investment in AR/VR technologies has exceeded a record $2 billion for the year 2016, despite the market still being in its earliest stages. Being considered the fourth wave of platform change (after PC, online and mobile), next-generation Virtual Reality models, economic products have evolved during 2015/2016 into a world leading hi-Tech sector with applications varying from entertainment and gaming industries to hi-end medical application in sensitive surgeries, simulation of pre-operation procedures, and virtual heritage. Predicted as the dominant technology industry for the coming three decades, Virtual Reality (VR) and Augmented Reality (AR) have opened the evolution of a wider range of subsidiary products and markets.

Moviemakers are exploring opportunities for director-uncontrolled viewer perspective in VR movies. Visual effects engineers improve motion-capture techniques for inserting real-life human holograms into virtual worlds. Movie studios look to additive VR/AR "bonus content" to help market their tentpole $100 million theatrical releases. Game developers look to create ethereal escapes and immersive horror and shooter games. And concert and sporting event producers look to engage (and monetize) fans on a new and exciting event viewing medium. (Dhillon, 2016) One example of an extensive investment programme is a series of studies, consultations and discussions run by Virtual Museums Canada (VMC) to support a virtual heritage-led Investment Program. Between 2011 and 2014, the Virtual Exhibits Program and the Community Memories Program made combined investments of $6.3 million (Canadian Dollars) in enlightening and educational digital heritage content to be developed by museums (VMC 2017). The Virtual Exhibits Program provided investment up to a maximum of $250,000 per production. The investments had led to the addition of 152 new productions to virtualmuseum.ca. These include sophisticated online productions, associated learning resources and exhibits that explore history, arts, culture, nature and science (ibid.)

# 10.0 ETHICAL and LEGAL CONDUCT

*"In virtual heritage, researchers have the ethical responsibilities of seeking authenticity, accuracy and original references to ownership of resources and materials"*

The Innovative approach towards heritage preservation, visualisation and communications within virtual environments poses a series of ethical and legal risks that needs to be accounted for and considered for a legally binding and rationally regulated frameworks. In this section of the policy, we set out two important aspects of governance of virtual heritage in Egypt, that could be equally applicable for other nations in the region. Below we construct this argument and need for action on two grounds, Ethical and Legal Framework.

### Ethical Framework

As virtual heritage develops as a mechanism for cultural heritage preservation, its equipment and devices will be frequently used by millions of people and for long durations. VR for heritage sites induces strong illusions of embodiment, where two characters are at play, the real and the imaginative. It would give authority of controlling another body, which may have significant psychological, mental and physical consequences. From the other side, the way in which heritage sites are reconstructed to accommodate such remote authority may include intervention and engagement that would also offer opportunity to affect the site, vandalise it and reshape it on such an imaginative platform. While virtual and digital heritage systems and applications offer a broad range of positive and additional resources for heritage documentation, preservation and representation, they also give space, though virtually, to vandalism, damage and abuse that may be frequent in the virtual space, but could translate into action in real life settings. Such processes and authority would involve a series of repercussions on the users and their cognitive stability. The ethical and legal conduct in virtual heritage should not be underestimated.

There may be a risk of depersonalisation, especially as fully immersive experiences have a bigger and more lasting impact on people's behaviour and psychology. In VR environments, we can be fooled into thinking that we are our avatars. Consumers must understand that not all of the risks are known in advance. The disorientation of contextual settings is rather problematic, as we are easily swayed by our surroundings. With the expansion of use of Virtual Reality in general and Virtual Heritage in particular, ethical concerns have been raised by researchers, governments and the general public. There are particular concerns about the possibility of

unanticipated consequences for the psychological states and self-images of users who are able to inhabit a virtual environment almost as if it is the real world.

The fact that VR can create strong illusions serves as a main reason why VH brings new risks. For Example, Immersion in VR can cause behavioural changes that last after subjects leave the virtual environment. VR creates situations where users' bodily appearance and visual environment are determined by the host of the virtual world. Such considerations raise the possibility that VR will create vast opportunities for psychological manipulation. A code of ethical conduct, however important, can never function as a substitute for ethical reasoning of researchers. For example, in virtual heritage, researchers have the ethical responsibilities of seeking authenticity, accuracy and original references to ownership of resources and materials. Out of concern for consumers of VH, in this context, there is a call for long-term studies into the psychological effects of immersion, which for good and bad have had varying effect on involved users and/or subjects. There more discrete emphasis is placed on the need for regulations regarding ownership and individuation of avatars, regulations that should also address concerns about surveillance and data protection.

It must be clarified that, in open democratic societies, regulations that restrict certain aspects of VR practices must be based on rational arguments and available empirical evidence, and they should be guided by a general principle of liberalism: in principle, the individual citizen's freedom and autonomy in dealing with their own brain and in choosing their own desired states of mind should be maximised. However, New technologies like VR for Heritage Visulaisation open a vast space of potential actions which has to be constrained in a rational and evidence-based manner. It is prudent to anticipate risks involved in the use and application of virtual reality and augmented reality to heritage preservation and documentation. Whether physical or virtual, human behaviour is situated and socially contextualised, and we are often unaware of the causal impact this fact has on learning mechanisms as well as on current behaviour. Unlike other forms of media, VR can create a situation in which the user's entire environment is determined by the creators of the virtual world, including "social hallucinations" induced by advanced avatar technology. Unlike physical environments, virtual environments can be modified quickly and easily with the goal of influencing behaviour.

## Legal Framework

Traditionally, preservation of cultural heritage, assets and products has been supported by legal frameworks and procedures which are largely based on formal criteria. 'National libraries collect and preserve publications through legal deposit of the national production, and there is extensive archival legislation defining when and how records must be transferred to archives for selection and preservation'. (ECPA 2002) However, the preservation of digital and virtual heritage products and material is still evolving, with no clear scope or comprehensive view on different types of products, assets or stakeholders. As digital and virtual heritage has continued to evolve over the past two decades, legislative frameworks have also been on an ascending trajectory. Yet, neither have reached a completely mature state. This gap in the governance and protection of digital and virtual heritage has played to the advantage of some privately owned technology firms with the necessary vast resources to acquire and reproduce material of significant heritage value.

Over the past 15 years, UNESCO has devoted much resources, research and events to the progression of preservation of digital heritage. Its activities included the issuing of its first Charter on Digital Heritage in 2003, 2007 and the Vancouver Declaration in 2012. UNESCO

Charter "The Digital Heritage as a Common Heritage", adopted in 2007, identified 'digital heritage' as including unique resources of human knowledge and expression that 'embrace cultural, educational, scientific and administrative resources', and include 'texts, databases, still and moving images, audio, graphics, software and web pages'. In Article 2, the Charter emphasises that digital heritage materials, especially those in the public domain, should be free of unreasonable restrictions, while encouraging a legal and practical environment that maximises accessibility. It insists on fair balance between the legitimate rights of creators and rights holders and those of the public (ibid.). Meanwhile, it acknowledges the challenges that come with digital materials and components such as the rapid obsolescence of relevant hardware and software systems and the uncertainty about resources, ownership, responsibility and preservation.

Of special importance, the Charter underlines the lack of supportive legislation to manage such creative, yet complex and legitimate endeavour. The evolution of technology has been too rapid and costly for governments and institutions to be in a position to come up with preservation strategies or legislation frameworks that both govern and support the diverse nature of digital and virtual heritage. Despite the mobile, fluid and non-physical nature of digital heritage material and products, the threats of their loss or false reproduction, and associated intellectual and cultural risks are inevitable. Hence, UNESCO member states are always encouraged to develop national legal, economic and technical systems, frameworks and measures to support and safeguard the appropriate methods of digital and virtual heritage preservation (ibid., article 4). These should include common standards and compatibilities that take into account the level of urgency, local circumstances, future projections.

Legal and technical frameworks that govern the management of digital heritage are crucial to prevent manipulation or intentional alteration of digital heritage as well as to deal with the reproduction of national heritage in digital and virtual formats. These would ensure that the 'content, functionality of files and documentation be maintained to the extent necessary to secure an authentic record'. A key aspect of these frameworks is the manner in which national preservation policies define and set guidelines on how digital and legal deposit in libraries, archives, museums and other public repositories should embrace the digital heritage.

In line with their responsibility for the preservation of digital heritage on the national level, governments need to designate national agencies to coordinate responsibilities for the preservation of digital heritage that normally extend to various public and private sector institutions, organisations and stakeholders. In most cases, ownership, responsibility and rights are shared amongst several groups and registries. Accordingly, the sharing of tasks and responsibilities may be based on regulations, legislations and expertise involved in existing systems, laws and activities. In particular, the role of private organisations as hardware and software developers, creators, publishers, producers and distributors of digital materials is important to support and facilitate public institutions such as national libraries, archives, and museums (Article 11, 2007). Collaborations may include also public and private universities that could provide training and research, knowledge exchange with relevant professional associations.

There are no specific regulations or laws to deal with the preservation of digital heritage. According to Egyptian law (117 of 1983), 'All archaeological material, ancient art and artefacts of any kind that are discovered or found within the Republic of Egypt are regulated cultural property'. It defines an 'Antiquity' as 'any movable or immovable property that is a product of … the various civilization[s] or any of the arts, sciences, humanities and religions of the successive historical periods extending from prehistoric times down to a point one hundred years before

the present'. (1983 LPA, Article 1) In this sense, Egyptian law focuses on the protection of Egypt's cultural heritage from treasure hunters, retrieving looted and smuggled antiquities while enabling the generation of revenue necessary to restore and conserve this country's heritage (El-Aref, 2009). The Egyptian law governing archaeology and the antiquities trade is Law no. 215 (31st October 1951) on the Protection of Antiquities, revised by laws no. 529 of 1953, no. 24 of 1965 and no. 117 of 1983.

In principle, this law was designed to confront and prohibit the trading or use of Egyptian treasures as gifts to foreign governments in exchange for services/ support, a practice which continued until 1974, when the small Dendereh Temple was handed to the American president Richard Nixon (ibid.). The last modification of the law was in 1983, and attempts in 2009 were not relevant to the evolution of digital heritage that emerged in the new century. The seeds of the problem of lack of legislation to deal with intangible and more mobile production/ reproduction of cultural heritage were evident even then. According to Zahi Hawas, the former Chair of the Egyptian Supreme Council of Antiquities, the laws do not respond to the challenges of the new eras of reproduction.

Attempts to alter the law in 2009 put in place new sanctions on using photographs of archaeological sites or artefacts for commercial purposes without the permission of the Egyptian government. Professional photography inside museums and archaeological sites was ruled as completely prohibited unless permission has been given. According to Hawas, an Italian group that paid $60,000 to photograph all of the objects exhibited within the Egyptian Museum had in effect rebranded and traded them for profit, recouping their investment and making $50,000 in profit by selling the right to re-use the photographs. Similar recordings and reproductions were made by Chinese experts, who later reproduced and traded Egyptian artefacts based on acquired visual and digital data (ibid.)

Discussions and debates with the officials of the current Ministry of Antiquities in Egypt revealed that persistent memories of painful experiences in the past have engendered only suspicious feelings towards any partnership with a third party. During the discussion with the Minister of Antiquities' deputies, concerns were raised over the acquisition of digital records of Egyptian antiquities and heritage sites for research and enterprise purposes. Based on previous experiences, one Deputy Minister mentioned that a foreign mission had taken 3D laser scans of several sites, to be shared with the Egyptian government. Instead, they found the data and records being used for different purposes.

In order to create digital preservation guidelines, the National Digital Information Infrastructure and Preservation Program (NDIIPP), for example, engaged in comprehensive research to author a definitive digital preservation policy statement for the Library of Congress. This allows the Library to "collect, preserve and make available" digital material for current patrons and future generations. To facilitate this initiative, NDIIPP collaborates with institutions around the world, to establish a sustainable digital preservation framework and maintain an on-going conversation about digital stewardship.

It must also be stressed that the digital preservation and recording of heritage is not limited to the professional hi-tech firms, corporations, research organisations, or governments. Community-based productions of multimedia have contributed significantly to the addition of massive big data of imagery and 3D modelling on crowd sourcing sites such as Google Earth. The documenting, transmitting, and revitalising of intangible heritage are significant domains in which local cultural property discourses are articulated and put into practice as individual contributions of ordinary people (Noyes 2006). This is particularly important in the age of the 'born digital' ethnographic object, where heritage documentation can become subjected to

unlimited circulation in the form of digital copies and remixes. National and local governments, heritage workers, anthropologists, curators -and, increasingly local stakeholders who represent their own cultures, languages, and heritage - are some of the agents of transformation of intangible cultural expression into digital heritage. All play a role in determining what media documentation enters the public domain, and what remains privately managed at the local level (Noyes 2006).

DRAFT FOR CONSULTATION

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### Article 40
Without prejudice to any severer penalty stipulated by the penal law or any other law punishing, for the violation of the provisions of present law, by the penalties stated in the hereinafter articles.

### Article 41
Whoever smuggles an antiquity outside the Republic or participates in such an act shall be punished by temporary hard labor or by a mulct not less than 5000 Egyptian pounds and
not more than 50.000,- Egyptian pounds. In this case the antiquity, object of the crime, shall be confiscated together with sets, instruments, machinery, and cars used in said crime on behalf of the authority.

### Article 42
The following shall be punished by imprisonment for a period not less than 5 years and not more than 7 years and by a mulct not less than 3000 Egyptian pounds and not more than 50.000 Egyptian pounds:
A - Whoever steals an antiquity or part of such that is owned by the state or hides the same or participates in any such crimes. In this case, the antiquity, sets, instruments, machinery and cars used in the crime are to be confiscated on behalf of the authority.
B-Whoever intentionally pulls down or damages or spoils or changes the distinguishing features of an antiquity or a historical building or a separate part of the same or participates in any such action.
C - Whoever executes archaeological excavation or participates in such work without a license. Penalty in this case shall be temporary hard labor and; a mulct not less than 5000 Egyptian Pounds and not more than 50.000  Egyptian Pounds if the doer was one of those working in the State, supervising or working in antiquities or official or workers of excavation missions or of the contractors having a contract with the authority or their workers.

### Article 43
The following shall be punished by imprisonment for a period not less than 1 year and not more than 2 years and by a mulct not less than 100 Egyptian Pounds and not more than 500 Egyptian Pounds or one of the aforementioned penalties :
A - Whoever transfers, without a written permission from the Antiquities Authority, a registered antiquity or an antiquity owned by the State or tears the same off its place,
B - Whoever transfers archaeological buildings or lands or parts of such to a residence or yard or store or factory or cultivates the same or prepares it for cultivation or implants trees therein or makes a barn or digs drains or irrigation canals or sets in the same any other such work or infringes upon the same by any other means
C - Whoever appropriates rubble or fertilizers or soil or sand or Other materials from an archaeological site or land without license from the authority or exceeds terms in the
license granted to him in quarries or brings to the site or archaeological place fertilizers or soil or waste or other materials
D- Whoever intentionally exceeds terms in the license granted to him for archaeological excavation
E- Whoever had an antiquity the disposal of which was effected contrary to that stipulated in the law
F- Whoever counterfeits- one of the ancient antiquity with the aim of deception or fraud

### Article 44
Whoever violates provisions of articles 2,4, 7, 11, 18, 21 and 22 of this law shall be punished by penalties mentioned in the hereinbefore article.

### Article 45
The following shall be- punished  by imprisonment period not less than 3 months and not more than *one year and* by a mulct not less than *100* Egyptian Pounds and not more than 500 Egyptian Pounds or one of either abovementioned penalties :
A - Whoever puts advertisements or propaganda posters on the antiquities,
B - Whoever writes or inscribes on the antiquities or puts paints on such,
C - Whoever spoils or damages an immovable or movable antiquity or separates part of such by way of mistake

# 11.0 TECHNOLOGICAL PLATFORMS

It took quite a few decades for software engineering to develop software packages that effectively respond to the needs of archaeologists, architectural historians to provide platforms of engagement with historic environments. To see and walk through ancient places in ways that approximate the viewpoints of the original inhabitants is a perfect tool for teaching young students or to teaching ancient cultures and buildings in the digital age. To develop these environments modelling language had to be created and modelling techniques had to reach considerable maturity. This took a good 20 years of computer graphics and modelling language to catch up. Over the past decade, the applications and use of virtual heritage environments have expanded enormously.

Interactive 3d virtual environments are usually coded using VRML (Virtual Reality Modelling Language) and experienced through multiple devices, whether specialist VR headsets, like Oculus Rift and HTC Vive which connect to computers, to smartphone-based adapted headsets using Web browser plugins (e.g., Cortona3d, FreeWRL), or built using game engines (e.g., Unity3d, Unreal) or specialty software (e.g., EonReality, Virtools) (Charara 2017). Once the headset and power source are secured, modelling and pre-rendered models are connected to the system. The synchronisation between the body and the model operates based on head tracking, controllers, hand tracking, voice, on-device buttons or trackpads. The development of these gadgets and devices is driven by the aspiration to perfection towards total immersion in the virtual world.

More advanced and professional platforms of display exist in specialist settings such as museums, university laboratories and Virtual Suites. CAVE, the Cave Automatic Virtual Environment, is a virtual reality display platform that consists of a cube-shaped dark VR room in which the walls, floor and ceiling are synchronised 3D aspheric projection screens (ibid). The user typically wears a VR headset or head-up display (HUD) and interacts through input devices such as wands, joysticks or data gloves. Within such settings, *The worlds can be created, dynamically revised, visited, and populated in ways that offer near first-person simulations of the ancient world*.

3-Point Cloud Laser Scanning, on the other hand, has introduced an innovative way to accurately record each detail and feature of the archaeological sites and buildings. The laser system characterises each point on the scanned object according to its colour and location in 3-dimensional space. It scans the surface of an object using one focused laser beam comprising three different wavelengths (red, green and blue), and records the reflected light using a "charge couple device" (CHIN 2009). Each point on the object is described by 6 numeric values;

positional values X, Y, and Z, and surface colour values R, G, and B. Colour intensity and texture measurements of the surface are accurate, depending on the quality of the machine, being completely independent of ambient light. The most recent and advanced laser scanners provide a scanning resolution as fine as 100 microns, recording 3D shape and colour simultaneously with high-resolution and perfect registration.

Technical applications of Virtual Heritage have expanded beyond the mere documentation and recording of individual objects. They are used in structural analysis, remote sensing, sensitive imaging and more broadly into regional conservation and planning strategies. The new and complex, yet highly accurate, LiDAR system has emerged as the leading technology in this field. LiDAR, an acronym for Light, Imaging, Detection And Ranging, is a development of the light and radar systems used for military applications. The principle behind LiDAR is simple; to shine a small light at a surface and measure the time it takes to return to its source. Light travels very fast - at about 300,000 kilometres per second, 186,000 miles per second or 0.3 metres per nanosecond, so turning a light on appears to be instantaneous.

The LiDAR instrument fires rapid pulses of laser light at a surface, some at up to 150,000 pulses per second. A sensor on the instrument measures the amount of time it takes for each pulse to bounce back. Light moves at a constant and known speed so the LiDAR instrument can calculate the distance between itself and the target with high accuracy. By repeating this in quick succession the instrument builds up a complex 'map' of the surface it is measuring (ibid). Using Professional drones, airborne LiDAR facilitates the collection of a multiplicity of data and tests them together to ensure accuracy. As the sensor is mobile and in constant movement, its height, location and orientation of the instrument must be always measured to determine the position of the laser pulse at the time of sending and the time of return. With tripod LiDAR a single GPS location and benchmark can be added for each location where the instrument is set up (CHIN ibid).

Photogrammetry, on the other hand, has emerged as the leading application for the creation of virtual archives of ancient artefacts and objectives in modern and national museums. It is the science of making measurements from photographs that translated images into 3D navigable objects. Its outputs are mostly 3D models, maps, drawings or measurements. To record archaeological sites or objects using photogrammetry, there is a need for both Aerial Photogrammetry and Close-Range Photogrammetry. In the former, the camera is mounted in an aircraft or on a drone. Multiple overlapping photos of the ground/building/ site are taken along a flight path and at specific but regular distances. These photos are processed in a stereo-plotter and then used in automated processing for Digital Elevation Model (DEM) creation. In Close-range Photogrammetry the camera is close to the subject and produces drawings, 3D models, measurements and point clouds. This type of photogrammetry (CRP for short) is also sometimes called Image-Based Modelling.

Generally, the documentation and production of heritage through virtual environments will require the integration of several of these systems along with others that are not within the scope of this document. However, the applications of technology in virtual and digital heritage are ever expanding. The above systems are a short list of closely related applications that this project endeavours to support and utilise.

# 12.0 GOVERNANCE & PLANNING STRATEGY

Any pragmatic approach towards Virtual Heritage, would raise a primary question;

*"Why should Egypt engage with VH to document and virtualise its valuable heritage sites and ancient treasures?"*

In trying to build on experiences of Virtual and Digital Heritage in Developing Countries as well as the relevance of their preservation strategies, one can directly highlight the following benefits of VH:

- *protecting heritage through technology and across cultures.*
- *giving users the sense of reality in presenting the unsafe environment, as they can recall a historical era, or future era to gain an experience.*
- *encapsulating a comprehensive set of historic interrogations and scientific research into a simple and condensed set of narratives.*
- *allowing tourists and visitors more control, where they curate their personal experience and interest in particular heritage sites in their own virtual tour.*
- *allowing visitors to transcend the limitations of the human mind, such as memory or problem solving limitations, and construct their own knowledge.*

However, the engagement with Virtual Heritage is not a straightforward affair. It requires a comprehensive set of studies, strategies, policies and infrastructure. Undertaking studies in those fields would only highlight the point at which the country and its institutions stand. Strategically, certain societies are in need of such technologies, but in fact cannot afford or manage them. In the case of Egypt, Virtual Heritage systems, methods and techniques have already been in use, mostly by foreign missions and a small number of local initiatives and organisations, the most prominent of which is Bibliotheca Alexandria's CultNAT, the Centre for Documentation of Cultural and Natural Heritage in Egypt. Apparently, there is much to gain from the wide use of Virtual Heritage Applications for the documentation of Egyptian Antiquities. But, there are greater risks too.

There are evident negative experiences of abuse of access conducted by a few international organisations and firms that used digital technologies for recording and documentation of Heritage in Egypt for narrow and private interests, and at time, profit. Due to the lack of existing legislation and a collaborative framework to govern such collaborations, the Egyptian Governments were left pondering what went wrong. They contemplate how several

ancient Egyptian antiquities were scanned, recorded and photographed, for what initially was research work, the results later being traded internationally for profit; how to protect national antiquities from those who have modern technologies and reproduce them for profit; to ethically manage the process and such collaborations with more advanced technological firms and institutions that the country's heritage so desperately needs.

Hence, through our several research colloquiums, workshops and engagement activities, the debate has shifted towards the essential aspects and frameworks necessary to produce critical research policy that would point the management of VH in Egypt in the right direction. Having investigated available charters and legislative frameworks worldwide, our team came to the conclusion that most of the existing recommendations and charters offer very generic and non-binding advice to institutions and firms on the use of Virtual and Digital heritage. Hence, we endeavoured to develop a set of principal elements that would inform best-practice policies, governance and support for the wide use of virtual heritage applications in a cultural heritage-rich country like Egypt and region like the Middle East. We anticipated that whilst each country has special conditions and situations, the Middle East countries have similar socio-cultural and governance structures that would deal with heritage in a similar manner. So, a research policy produced within the context of Egypt would similarly be relevant and equally applicable to other countries in the region.

In this section and based on our global perspectives investigations, we propose a multi-faceted framework and best-practice policy that would cover the different factors and domains of activities involved in the use and implementation of Virtual Heritage. These include: *Governance*, *Infrastructure*, *Skill-Base*, and *Investment*. Each will be clarified in a set of simple diagrams that show the steps of pathways of actions that would help the industry and governance to develop in tandem with the national need.

### Governance

Central aspects of current shortcomings in the management of virtual and digital heritage in the region are connected to the lack of expert input, advisory and independent governance structure to inform governmental decision-making and long term planning. Symptomatic of the strictly hierarchical structures of management and decision making, current decision making is exclusively made by the government departments concerned with the management of heritage according to its primary dynastic classifications. Whilst those departments are staffed by archaeological experts in the field, limited interdisciplinary experiences and/or technical knowledge would be expected. By virtue of their evolution, virtual heritage technologies and systems are consistently and rapidly changing, offering new capabilities and capacities of which no ordinary archaeologist would be normally be aware. Moreover, private firms, technology and VH operators would be more knowledgeable than permanent and conventional archaeologist employees who manage and oversee those projects. In short, the balance of government oversight would be inconvenient, leaving the government exposed by limited knowledge and ability to detect how much of the information and records is being documented and for what purpose.

Moreover, in response to the frequent concerns regarding the transparency of projects and investment allocations and technical capacity for oversight, we propose a governance structure for virtual heritage that involves three branches of management. The first, Ministerial Oversight, would provide long and short term planning strategies, policy development, legislative frameworks, while setting out the national goals, objectives, priorities and projects; in short,

management procedures. Those policies and legislations would come under the democratic oversight of Parliament. Due to the technical complexity, interdisciplinary and far-reaching impact of these projects, an expert Committee consisting of a group of independent experts in the field is necessary to review, approve and monitor Virtual Heritage projects and report back to both the government and Parliament. This structure would not entirely eliminate all potential risks, but it would offer a comprehensive and multi-layered approach to management through different oversight procedures. Those would not hinder project progress with bureaucratic procedures. Rather, they would implement an overarching review of the policy, procedures and implementation of projects, in what is increasingly becoming a crucial and advanced technology industry and market.
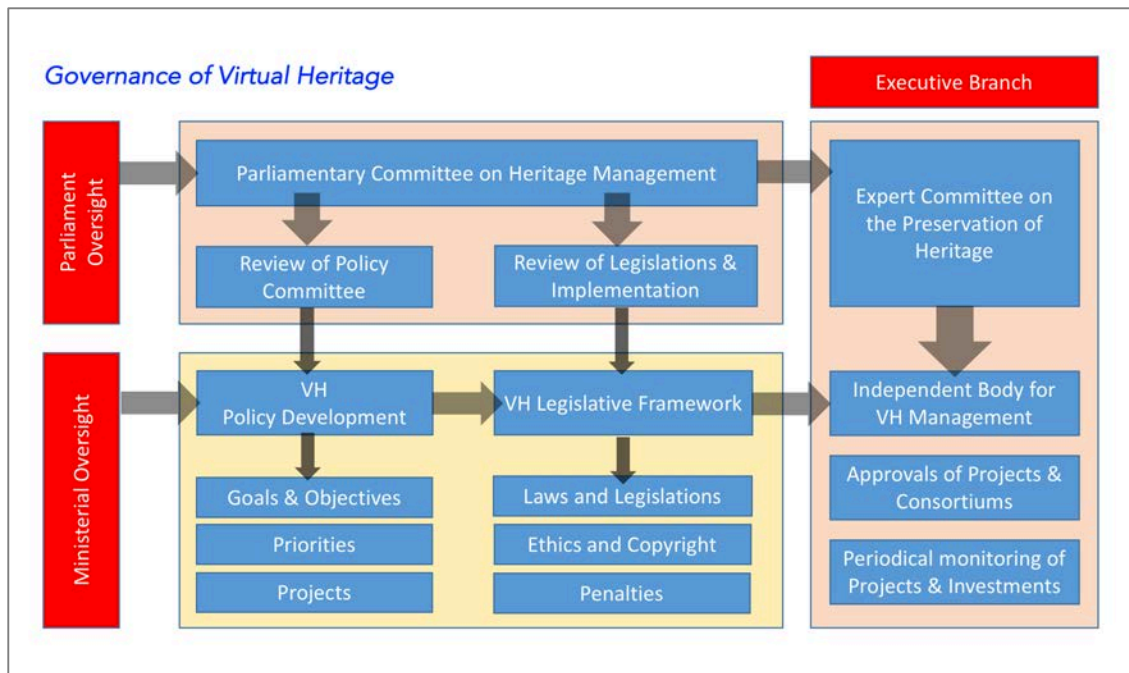


*Fig.6 Proposed governance structure for the management of virtual and digital heritage in the Middle East and in Egypt.*

### Infrastructure

Most of the current infrastructure of Virtual heritage in Egypt is managed by either mainstream organisations or private firms; first, governmental institutions such as CultNAT are run by Bibliotheca Alexandria or other research institutions such as Cairo University, Alexandria University, National Institute of Astronomy and Geophysics, the local partner on this project and others; second, the private firms specialise in Virtual reality applications in general. While the former, as part of the HE sector, do not compete in VH projects through private contracts and their position in the public sector limits their capacity, expertise and business model, the latter lack basic expertise in the field of digital and virtual preservation of archaeological and cultural heritage. In the current climate of suspicion and bad experiences in the field, active projects that use virtual heritage are based on partnerships between local HE institutions and specialist foreign research organisations, companies and heritage firms. Those projects are mostly supported by foreign aid and non-governmental research grants. They provide financial support to foreign partners with equipment and systems that are never part of the local infrastructure of

Virtual Heritage. Hence, even if the local partners do gain access to the data, its utility is very limited due to the absence of permanent technological infrastructure in Egypt.

Over the course of this project's duration, from Feb 2016-April 2017, we realised that only by bringing both types of organisations together to collaborate on actual projects could the expertise of staff, young researchers and entrepreneurs be developed and improved; hence a new sector of virtual heritage could evolve. However, in the absence of a sufficient number of virtual and digital preservation units with constantly upgraded systems, expertise and staff, keeping pace with changing technology is difficult. Equally, the limited use of private sector and technology companies in Egypt in Virtual Heritage projects has only succeeded in limiting the capacity of the market and available training opportunities to international corporations, archaeological firms and foreign institutions. There is necessity to invest in essential infrastructure for digital virtual preservation of heritage in both public institutions, and in private firms. This could only happen through allocation of projects, possibly those that are less sensitive, to small and medium enterprises in Egypt to help them grow and accumulate experience, expertise and equipment. It must be stressed that it is unlikely that reliance solely on governmental support would provide sustainable infrastructure for heritage management in Egypt or the Middle East as a whole.

*Skill base*

Shortage of a skill base in the field could reflect the same infrastructure pathway in terms of challenges, capacities and experience. The only addition to the argument here relates to aspects of education and professional graduate training. Through our research and debates sessions, it has become clear that archaeological courses in Higher Education Institutions in Egypt provide over 8000 graduates across several institutions. Yet, most of those courses are theory-based with limited on-site experience. If this could partially be true for conventional and progressive archaeological studies, Digital and virtual archaeology and heritage is in fact hardly existent in either undergraduate or graduate courses. Moreover, we could detect no professional training on virtual and digital preservation of heritage apart from at the Grand Egyptian Museum and Bibliotheca Alexandria, where a few projects funded by the British Council and Japanese and American Heritage aid offer infrequent opportunities for such activities.

With the coverage of virtual and digital heritage projects and applications increasing into every aspect of archaeological finds and cultural heritage documentation, there is urgent necessity to rethink the direction of Archaeology and Heritage Preservation courses in Egyptian and Middle Eastern Universities. The shortage of skill base is alarming and aligning the graduates' skills with the needs of the market, projects and national priorities is a must if Heritage preservation is to become sustainable for the foreseeable future.

*Investment*

Heritage Tourism has always been one of the leading sources of hard currency for the Egyptian economy, with a contribution of up to 12% of GDP. However, the effects on heritage tourism in recent years, due to instability, difficulty of travel and security risks, have greatly impacted the nation's economic stability as a whole. These few years have only served to shed light on the importance of heritage preservation and its critical importance to the health of the economy. However, the only official government branch dealing, by contract, with heritage preservation,

the Ministry of Antiquities, receives no funding from the Egyptian Parliament; i.e. does not have a formal budget. Rather, the salaries of its staff, employees and equipment are all funded from the admission ticket fees paid at the entrance to its monuments and historic sites and museums. So it is safe to say that the investment in this sector in Egypt is staggeringly low, and does not have the capacity to initiate, train or even offer strategic investments that could have far reaching positive impact on the long-term recovery of heritage tourism in Egypt.

Financial support through targeted foreign aid is normally restricted to specific projects with clear outcomes. Whilst offering help in certain preservation projects, they cannot replace the necessary investments in professional training, growing the skill base or offering critical and comprehensive infrastructure, not only for digital and virtual heritage, but for the development of genuine and novel projects of heritage preservation that suit Egypt's future needs. The integration of private investment and public-private partnerships in heritage projects might be an alternative route to successful and sustainable investment. The Heritage Lottery Fund in the United Kingdom offers a good model for non-governmental funding of heritage preservation and development projects that does not rely on governmental support, yet is under close scrutiny of specialist oversight by both Historic England and other government and parliamentary committees. Other models could be explored for fund-raising, as a sustainable source of investment in virtual heritage. It must be stressed, as we highlighted earlier, that whilst the market for Virtual Reality Technologies in 2016/2017 is approaching $2billion, the market for virtual heritage is well set to achieve a huge share of online and virtual tourism in the near future. Smart investment in VH in Egypt with the presence of good infrastructure and legislative frameworks would guarantee the Egyptian economy a good share in the market and in innovative and creative industry.

# 13.0 PRINCIPLES of GOOD PRACTICE

Building on the critical analysis of International charters such as UNESCO Charter on Digital Heritage in 2003, 2007 on "The Digital Heritage as a Common Heritage", adopted in 2007, Vancouver Declaration in 2012 and London Charter for the Computer-based Visualisation of Cultural Heritage, originated in 2000 and re-edited in 2009, we have envisaged developing a set of principles of good practice. Those principles emerged as a result of verifying such international efforts in building universal values and QA systems against the realistic conditions of the Middle East and Egyptian context, including research environments, technology advancement and legal frameworks. Those principles and guidelines are never meant to be prescriptive or mandatory to each project as a legal prerequisite, but aim to offer focuse insights on considerations and successful experiences in running virtual heritage projects in a smooth and convenient manners, whilst protecting the rights of both the owner and consumer of architecture, built and cultural heritage.

It is mandatory, however, that proper governance structure and legislative frameworks are set with clear provisions of responsibilities, commitment and penalties. So, those principles must be read in conjunctions with other sections of this policy documents for them to work. We need to acknowledge that the mobile, fluid and non-physical nature of digital and virtual heritage products just reinforces the suspicious and lack fo trust between involved parties. The lack of clarity of rights and responsibilities, either force bad practice, or for reputable and successful businesses and industries to stay away from the field in the region to avoid subsequent legal consequences. These principles and guidelines will only strengthen the national position of Egypt and other Arab States to meet the UNESCO requirements of developing legal, economic and technical systems, frameworks to safeguard digital and virtual heritage preservation. Below is a summary of the principles, which were inspired and guided by Hugh Denard's edited version of the London Charter (Draft 2.1, 7th February 2009).

**Virtual Heritage Cairo**

**Guidelines for Governance and Management**

**Of Virtual Heritage**

# Article 1
## Knowledge

Whilst historic narratives are subjective and debatable, they resemble essential part of the background information on heritage documentation. Heritage, tangible and intangible, must be read and analyzed within context, using hard and credible evidence to verify practice and narratives.

A. All Projects, practices and teamwork on digital and virtual heritage documentation and display must commit to undertake comprehensive research and to identify original resources, credible physical evidence, contextual analysis in structured and well documented manner, as part of the project outputs. that transcend the boundaries of intellectual disciplines.

B. All Project teams must commit to scrutinize different methodologies and systems available to fulfill the purpose of the project with minimize the impact of the project on the original objects, artefacts, building or other cultural heritage material.

C. As audience and end-users will commonly take virtual heritage products and material for granted, Project and specialists teams must commit to the verification of authenticity of cultural heritage material and practices as visual sources may be affected by ideological, social, religious and aesthetic changes.

# Article 2

## Data Collection and Process

The production of digital and virtual datasets and environments of cultural heritage material needs to be part of the accurate survey and documentation of heritage sites and objects. These records and datasets needs to be verified for authenticity as part of the preservation record. Such records and datasets must be recorded with the authorities with official responsibility for conservation records and information of historic and heritage assets. Such records needs

A. Survey and records of the survey of buildings need to be certified and registered in structured national and online database. While hard data is collected from site and could be accurately verified, socio-cultural data needs to be recorded but differentiated from the physical records, as interpretive.

B. Recording and documenting historic buildings and artefacts data should be registered as intellectual property and must be protected as copyright Intellectual Property or official records. Certified registration of this data needs to be shared with the Official and national authorities.

C. Documentation strategies need to facilitate rigorous, comparative analysis and evaluation of computer-based visualisations, and to facilitate the recognition and addressing of issues that visualisation activities reveal.

D. Transparency about what is registered and hard data and what is interpretive and subjective is essential to be made clear. End-users need to know what a computer-based virtual models and visual display seeks to represent, current condition, an evidence-based restored sites and contexts or hypothetical reconstruction with subjective narratives.

E. Documentation of the creative decisions made to process documented evidence and surveys to produce virtual heritage model and environments should be made available to public audience. This must differentiate between original sources, implicit knowledge, rational reasoning, and digital modelling.

**Article 3**

**Research Ethics and Intellectual Property Rights**

A. The rationale for choosing a specific methodology, digital technology and recording techniques must be verified, justified and discussed in advance of commencing any work. This must take place during research design stage, which would subsequently inform subsequent processes, implementation and outcomes.

B. For research, IPR and ethical adherence, these methods must be granted approvals and confirmation of datasets to be collected, documented and archived in advance of grant, or fund being granted.

C. Similar to research ethics approvals for medical research, Immersion in VR can cause behavioural changes that last after subjects leave the virtual environment. The use of Virtual Reality for heritage simulation will create vast opportunities for psychological manipulation. Hence, a code of ethical conduct must be developed and adhered to in respect of virtual heritage environments. This should clearly demonstrate the ownership and copyrights, and should also address concerns about surveillance and data protection.

D. Based on empirical evidence, New technologies like VR for Heritage Visulaisation open a vast space of potential actions that must be grounded in evidence-based processes. It is prudent to anticipate risks involved in the use and application of virtual reality and augmented reality to heritage preservation and documentation. Hence, advanced risk assessment procedures must be undertaken during the planning stage that determines potential risks and mitigation procedures the team would take to not only limit the risks/dangers to the physical state of the archaeological or heritage sites, but also to the abuse or uncertified use of digital data and/or content. This should include data security, storage, potential hacking and uncertified intrusions via online environments, etc.

E. Unlike other forms of media documentaries, Virtual Heritage can create a situation in which the user's entire environment is determined by the creators of the virtual world, including "social hallucinations" induced by advanced avatar technology. This might have more impact on school children more than adults. Developing learning activities and applications for children need to be scrutinized by specialist of Children education and behavior specialists.

F. Whilst Virtual and Digital heritage applications produce predominantly visual material and output, supporting Documentation and evidence must be accompanied with each visual element to simultaneously disseminate background information, resources used and references that were used in the production, including infographics, textual reports, video and/or audio commentary.

**Article 4**

**Implementation**

The implementation of a digital heritage documentation would have to consider key players who have vested interest in the process, benefit from its outcome and product, and those impacted by its operational procedures. Hence, an implementation plan in collaboration with local stakeholders, local authorities, beneficiaries must be developed and adhered to throughout the project. In situations where the end-users, as in virtual environments, are not known, a sample of a group of test-users' needs to be assembled for validation and testing purposes.

A. Depending on the nature of the project, project managers / leaders need to map how their project and operational procedures meet essential requirements of these principles and when. These should be in line with the project's own aims and objectives and within its time frame.

B. Every project on documentation of heritage through digital or virtual techniques should ensure the enforcement of ethical and legal conditions in association with the local authorities. Frequent system of monitoring and oversight by independent specialist personnel must be included and budgeted for throughout the project.

C. All staff, researchers, technical staff and professionals must be trained or certified specialist in dealing with digital heritage preservation.

D. Records of documentation, dataset, and surveys (physical, digital, imagery, electronic) must be kept in secure database and storage space (secure store and online/ cloud storage).

E. All such documents must be registered and coded with respect to Ownership, Intellectual Property Rights, under which conditions they could be accessible to the legal shareholder/owner of the Heritage in question. They should be registered as part of the heritage asset.

F. For Digital/virtual Heritage Outputs to be displayed in public domains, or used for commercial applications, a certification of completion for the project and "*Approved Product*" must be issued by the Ministry of Antiquities or another authority with legal provisions of such approvals. This is to prevent any piracy, fraud or illegal use of incomplete work/data/ outputs.

G. Legal procedures in specialist legal hearings and representations must be taken against collaborators/ partners/ organisations who fail to adhere to the guidelines of these procedures. It should have considered a criminal offence if the output of these projects or incomplete version of it are used in public domains without prior certifications.

**Article 5**

**Methods, Tools and Techniques**

Digital and virtual preservation, recording and disseminating cultural heritage need to use the most relevant, cost efficient and innovative techniques that ensure accurate recording, processing and communicating its output in professional and accurant manner.

A.  An objective, systematic, and documented evaluation of possible methods and techniquess should be carried out as part of the initial research to verify and validate the suitability of the used technqiues, systems and platforms. The same could be used to propose a new method and system, but based on evidence-led analysis and potentials for future endurance.

B.  It must be stressed that choices of methods, techniques and platforms have long term financial implications due to the changing operators and developrs of virtual and digital applications. Hence, scrutiny of long-term validity of datasets and products must ensure their electronic files and data remain relevant to mainstream technology applications.

C.  Used methods and techniques must make best use of other contextual aspects of heritage including historics studies, socio-economic conditions and most effective impact on both cultural heritage research and local communities; i.e., role of audience and local communities in informing the outcome of the project.

D.  Specialist Training to officials involved in the monitoring and oversight of the projects must be delivered to reach a consensus on the suitability of the method and convenience of the output in line with the government/ national strategy for heritage preservation.

**Article 6**

**Sustainability & Endurance**

Pre-impementation study on market strategy, feasibility and economics of the project, used method, its future applicability and endurance of outputs. This will feed into both short-term and long-term benefit of the project and its outcome. Hence, strategies must be developed to ensure sustainability and urability of material and products of cultural heritage digital and virtual preservation, including processes, outcomes and documentation. This prior-planning should reduce the risk of loss of datasets and detailed records of intellectual, social, economic and cultural heritage.

A.  Each project team must should consider the sustainability of used methods, processes and storage and most durable form of archiving digital and virtual heritage processes and outcomes, both analogue or digital. This should enable the use of raw data and final outcomes.

B.  Implemented strategies should aim to preserve the recorded and documentation data and files through multi- storage strategies, registration of data in national heritage archive. The stored data must be coded and accompanied by contextual and supporting information that facilitate convenient use in the future.

C.  Project teams should consider the multiple applications of their preferred and documented data for different purposes, disciplines and professions. The stored and registered data should be made available in alternative format that enable users and professionals from different backgrounds to be able to use it for further scientific research and analysis.

D.  In addition to the storage of the digital datasets and files, a hard copy of printed information should be stored on different sites as a precaution of the unlikely loss of digital ability or platforms for reading electronic files. This is important in light of recent adversaries towards heritage sites during armed conflicts or by terrorist groups. Digital files are more vulnerable to loss due to the limited size of its storage, devices and lack of visibility.

# 14.0 ACTION PLAN

The scrutiny of Virtual and digital heritage industry, applications and production in the Middle East shows that national governments still has an incomplete and narrow perspectives of existing creative capacity and the contribution of its cultural and creative sectors to its economic and social achievement in the emerging futures and markets based on online environments and the cloud. As a result, the political establishment, governments and local authorities often take the view that investment in cultural preservation is of a secondary importance, not a priority and have difficulties in linking culture to innovation, industry and markets.

In the absence of comprehensive and inclusive database of current work on digital and virtual heritage projects makes it difficult to consider appropriate policies, deal with resulting problems on strategic level. There are serious questions that can make heritage preservation an income generating activities rather than resources and time consuming investment without serious economic reward or benefit. How can virtual and digital heritage preservation contribute to a creative economy? What is the market value, outreach of virtual heritage production in the Middle East? Does the region do enough to stimulate culture-based creativity and technological innovation?

A reliable database and archival system of projects, products and partnerships is important to analyse completed works and viability of products and applications, develop necessary policies, identify competitive strengths and develop a better understanding of virtual and digital heritage market evolution. This is critical and important if the Egypt as a nation is willing to support the development of a creative economy and gain a better understanding of the next generation of virtual applications that benefit national heritage preservation and generate new jobs, market opportunities and generate much needed income.

As part of the Action Plan for this Policy, we propose the following programme of actions that will constitute an initial five-year work plan aimed at the reformation of current systems of management of virtual and digital heritage during which, regular consultation, dissemination of data, statistics and benefits of these projects and opportunities.

First, this policy document acknowledges that:

- It is practically difficult to measure the value of the output of creative and innovative sectors that are not industrial such as museums, galleries and libraries but also performing arts that are relevant to the fields of cultural heritage.

- There are concerns and unclear boundaries between copyright and neighboring rights royalty collection and intangible assets in general. These are not clearly identifiable from official statistics.

- Detailed data on new distribution and production or innovative forms of digital and virtual heritage simply fall outside the scope of national heritage preservation surveys; hence, there is not much information on this sector or its contribution to the economy or society in general.

- Official statistics do not provide a way to measure cultural diversity (whether in production, distribution or consumption).

Hence, under this Policy Document and Action Plan, we propose the relevant authority (designated department is different amongst countries and authorities) will need to mainly:

- Open a dedicated section in the Ministry of Antiquities, Ministry of Culture or their equivalent departments, a specialized unit with experts on the management of digital and virtual preservation of heritage.

- Initial an independent consultative body made of experts in the field to advise the national governments or concerned departments on development of policies, legislations and governance of industry-led creative projects.

- Initial a dedicated website and datasets that offer guidance on policies, frameworks and practical advice on how to deal and manage creative projects on digital and virtual heritage. This will identify potential benefits and useful support tools, whilst alert and warns against bad practice and problematic concerns.

- Initiate and develop necessary and relevant literature, research projects and publications that cross the boundaries between industry and innovative research in the field.

- Encourage and support specialist courses and training programmes at the graduate and post-graduate levels to address the lack of skills and knowledge in the field.

- Develop routines and estimation procedures for the costing, fees and time scale and procedures of approvals, include sets of information on best practice projects and examples both nationally and globally.

- Produce and disseminate thematic and periodic statistics on employment, market value, income generated and successful examples on trade in digital and virtual preservation of heritage, includes income generated, investments made and innovative outcomes. These annual reports need to be disseminated on the relevant national authority websites to ensure the credibility of such data.

- Identify challenges and possible solutions for the production of culture heritage preservation and its impact on international trade in cultural services, cultural participation, private expenditure and public spending in culture;

- Setting up specialist priority investment programme on creative industries in the field of digital and virtual. This could be open for competitive projects, knowledge exchange, postgraduate and vocational training in such creative sectors.

- Initiate and undertake a qualitative review of current Archeological and heritage preservation courses for their relevant to the changes in the modern systems and practices of preservation in the digital age and virtual environments.

- Initial business registers, professional associations (including rights management bodies), 'Big data' providers (Internet), and cultural observatories that will identify those who have credible record, experience and professional qualifications that are necessary to have before being considered for projects or investment.

# 15.0 RECOMMENDATION

Throughout the duration of the project, Virtual Heritage of Medieval Culture, the research work, investigation, engagement activities and practical projects involved a multi-layered process of exploration of creative research and innovative technology industries could develop practical and beneficial applications of virtual heritage in the Middle East. The project uncovered multiple aspects through which digital and virtual heritage impact our societies. As heritage (cultural, built, and art) ingrained in the identity, psyche and everyday life of many people and communities, preserving them through virtual environments would offer new opportunities, economies and markets that would make heritage relevant to the future. However, heritage relation to society is dynamic and changes with time. Engagement with innovative digital technologies to ensure the presence and relevance of cultural and built heritage to the future of our online interactive environments is becoming an essential facet of its contemporary evolution. There are several gaps to fill, however, in order for the virtual heritage industries, markets and businesses to thrive in the region. These gaps relate to understanding of its processes, skill gaps, necessary infrastructure, research depth and above all the need for a legislative framework to enable its professional processes. In the previous sections, we detailed necessary strategies, systems and legislative frameworks that would enable this industry to evolve, get needed support and under adequate oversight of specialist and national authorities without compromising the independence of private entities.

This effort has been designed to regulate, administer the govern such fluid relationship between main stakeholders, national institutions' authority and ownership of heritage and historic assets from one side, and private enterprise that energize and develop creative and economic applications with market and business values from another. This policy document has covered such inter-related relationships, highlighting areas of collaborative efforts, necessary partnerships, investments, trainings and market studies, but also warned against concerns and worries of inadequate and abuse of access to heritage material, content and sites without clarity on rights and responsibilities. Hence, the findings and recommendations of this project and policy document could be summarised in the following points:

- Archaeological and cultural heritage are valuable and indispensable assets of societies that play significant roles in the future of those societies. They should be given serious consideration not only on the cultural front, but also in creating a socio-economic and sustainable vision of societies.

- Digital technologies and virtual heritage applications have the potentials for saving endangered and vulnerable heritage sites through early stage detection and analysis of structural failures.

- Virtual Heritage encompasses a wide spectrum of technologies that involve a wide range of equipment, instruments, software and tools. Their applications range from survey, recording and visualization such as VR/AR to remote non-intrusive sensing, high sensitive imaging, and inspection of paintings in exhibitions, museums and galleries.

- Tech companies are advancing technologies that will in no time be able to alienate governmental restrictions on documentation, recording and reproduction of heritage. Hence, a progressive approach towards engaging with and understanding virtual and digital heritage applications is needed to allow appropriate regulation.

- Restriction and prevention is not a viable policy for dealing with heritage management and protection in the digital age. New technologies are developed that compromise any security restrictions that prevent engaging with heritage sites.

- Reproduction of heritage through digital and virtual forms raises certain ethical, moral and legal concerns. These concerns require further collaborations from professionals and researchers in different fields of inquiry.

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www.virtualheritagecairo.com