Dusty Archaeology and Digital Technology

The added value of digital reconstruction technology in Dutch archaeological museums

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Master Thesis

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Preface

Ever since I was a little girl, I dreamed of working in a museum and being surrounded by the knowledge of the past. This did not change during my study as I succeeded in my Bachelor Archaeology and proceeded to the master Museum and Collections. However, during my visits to different archaeological museums in Europe, something bothered me. Technology is much integrated into our lives. Nowadays, almost everyone is carrying a smartphone and with the use of TV, radio and social media, interesting information can be transferred. It bothered me that while walking in the National Archaeological Museum in Athens, endless rows of Greek vases were presented with no digital technology included to modernise the displays or to make the content easier to absorb. The visitor was recognized as an inferior and inactive viewer to my opinion. Fortunately, this research will present that not all museums are still stuck in their old roots of practice and do adopt interesting new technologies to enlighten their displays. It will make history appealing again besides all the other interesting developments in this rapidly changing world.

This study is executed during the middle and end of the year 2019. Due to a difficult start, the duration of the writing of my thesis was longer than expected. With the help of, first of all, Dr. Mirjam Hoijtink, my supervisor, I managed to finish my thesis. She was both strict and hopeful, a combination I certainly needed. I am very grateful for her help and perseverance throughout the whole process. The museum professionals I interviewed were all very helpful for which I also want to show my gratitude. I could never have completed my thesis without their cooperation. Besides, I want to thank Els Munter, the study coordinator of Art History, who helped me through some rough times while writing my thesis in the summer. Finally, I want to show my appreciation to my family, close friends and boyfriend who listened to all my complains and struggles and helped me bring this thesis to a good end.

Enjoy reading this thesis!

Katelin Post

Leiden, 24 October 2019

Abstract

This thesis aims to investigate the added value of digital reconstruction technology in archaeological museums. Recent wars and conflict zones have made the world aware again of the vulnerability of the archaeological record. Therefore, the reproduction and reconstruction of archaeological material become more relevant to archaeological museums. New cutting edge techniques make museums able to perform admirable results for the communication about the content of the exhibition, the objects themselves and the museum. However, these technologies, methods and devices have both advantages and disadvantages. What defines them to be of added value to the archaeological museum?

The following research question has been composed for this study: How can digital reconstruction techniques and devices be of added value to the transfer of the meaning and content of archaeological objects in archaeological museums? This research question is divided into several subquestions and answered in the three chapters this study contains. The first chapter will discuss the definition and history of reconstruction in archaeological museums, the second includes the first case study (*Nineveh - The Great City*) and the third chapter includes the second case study (*Etruscans. Eminent Woman, Powerful Men*).

The study is set up as an inductive research because no applicable theories about added value were found in this field of research. The study will analyse academic literature, reviews, official documents published by the museums, interviews and questionnaires.

It can be concluded that the digital reconstruction of the Cerveteri Tomb and the digital devices in the Nineveh exhibition were of added value in three ways: to the archaeological museum and archaeological research, the archaeological material and the visitors of archaeological museums. During the process of conducting this study, critical notes and limitations appeared. Important critical notes were the undefined expectations between the technicians and the museum professionals and the difficulties with communicating about the complex framework of questions and choices behind a reconstruction. The visitor only observes the end product of the digital technology but is not part of the process behind it, while this might be valuable to understand. Moreover, no clear answers can yet be made about if the increase in the amount of digital technology is of added value per se. There is still a long way to go to answer and solve all the questions, problems and limitations that are indirectly connected to digital technology in museums. Questions that should be answered by both museums and visitors. It is identified that authenticity is a key concept that is examined as the backbone of many issues, and it should, therefore, be better understood to analyze, interpret and initiate new future projects.

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Introduction

While walking through the National Archaeological Museum in Athens a few years ago, a doubtful perception became apparent. Endless rows of Greek vases inhabit a large part of the first floor and overwhelm the visitor with a feeling of the infinity of Greek archaeological material culture and the basic look-and-learn pedagogy. A question arose. Are all museums still stuck in their old roots of practice or have they evolved and adjusted to modern forms of communication with the use of for instance digital technology? While this question can easily be answered with: yes, they have changed, the subsequent question why this did not happen at the museum in Athens is harder to answer. How can the museum do this better, and what can they do when they do not have endless collections of common material culture due to destruction or looting?

It is expressed many times by authors that heritage is important to people to such an extent that it can be considered common sense.[1] The study and preservation of cultural heritage are driven by a search for roots, spiritual worship or another kind of cultural identity which has led to the recognition of the universal educational value of heritage.[2] The protection and promotion of cultural heritage have been powerful goals and even core aspects of international organisations like UNESCO as they are safeguarders of tangible and intangible World Heritage for future generations.[3] The archaeological artefact is in this context one of the most concrete parts of cultural heritage that people want to protect and save.[4]

Unfortunately, recent wars and conflict zones have made the world aware again of the vulnerability of the archaeological record. Archaeological artefacts are vulnerable in many ways. While the archaeological record is being damaged, destroyed and affected, the reproduction and reconstruction of archaeological material becomes more and more relevant to archaeological museums. New techniques and resources make museums able to perform admirable results with real-life like models and multisensory experiences in which the communication about the content of the exhibition, the objects themselves and the museum in general benefit from. For instance, museums are now able to produce a 3D printed archaeological replica for a decent price by which they can improve their accessibility for their audience.[5] A Virtual Reality simulation can be used to immerse visitors into an archaeological site and improve their experience and memorability by the creation of a more active learning

[1] Smith, Messenger, and Soderland, *Heritage Values in Contemporary Society*, 15; Mathers, Darvill, and Little, *Heritage of Value, Archaeology or Renown*, 3-6; Carman, *Against Cultural Property*, 45.
[2] Cleere, *Archaeological Heritage Management in the Modern World*, 5-10.
[3] "The Value of Heritage"," UNESCO, updated November 24, 2016, https://whc.unesco.org/en/news/1592/.
[4] Howard, "Editorial: Valediction and Reflection," 484.
[5] Ballarin, Balletti, and Vernier, "Replicas in Cultural Heritage," 55.

space with multisensory aspects.[6] Augmented Reality was adopted to overlay skin over animal bones at the Smithsonian Museum in Washington through the use of an app.[7]

Museums have evolved with the use of cutting edge innovation. It is without question that these new technologies, methods and devices have advantages and disadvantages for the archaeological museum. Although the digital reconstruction of an archaeological object, that is destroyed or affected, is a way to bring the object back to life and use it in the interest of the public, authenticity issues are questioned about the value of objects as they are a representation of reality, in this case digital copies of the real objects. While the technology could be used to broaden the audience experience in terms of senses, this has in some cases resulted in negative experiences.[8] Devices that support Virtual Reality or Augmented Reality simulations can create multisensory experiences for visitors and active learning spaces for children with for instance game-like features, but the devices are still not 100% trustworthy, have technical problems and their sustainability is dependent of the experience of the user. Research has demonstrated that elderly people are not always that common with the devices.[9] Besides, manuals with details about the manufacture of replicas and reconstruction for the use of an exhibition are not always clearly communicated by museums or the companies that make the models. Becaue of this, the amount of added interpretation by the designer against the factual data is not apparent.

Digital technology is used as a device to transfer meaning and value of objects in archaeological museums to the public. This meaning and value can be emotional, historical or aesthetical. According to the philosopher Krzysztof Pomian, a dichotomy exists between two different types of archaeological museums; art focused-archaeological museums and technique focused-archaeological museums.[10] Objects are valuable in both museums as intermediaries between the present and the past. A difference arise, however, when it is observed how the meaning of objects is created.[11] The art focused-museum allocates meaning through the aesthetical value of things that is always present within the object itself. Materiality is subordinate to its meaning and thus the communicational device should transfer aesthetic meaning to its admirers. The technique focused-museum values the historical meaning and functional use of the object in the past. The materiality is in this case

[6] Hupperetz, Pietroni, Pletinckx, Ray (ed.), and Sannibale, *Etruscanning*.
[7] "Bone Hall," National Museum of Natural History, accessed October 10, 2019, https://naturalhistory.si.edu/exhibits/bone-hall.
[8] Wilson, Stott, Warnett, Attridge, and Smith, "Evaluation of Touchable 3D-Printed Replicas in Museums," 459.
[9] Nofal, Elhanafi, Hameeuw, and Van de Moere, "Architectural Contextualization of Heritage Museum Artifacts using Augmented Reality," 57.
[10] Pomian, *De Oorsprong van het Museum*, 81.
[11] Ibid., 84.

superordinate and shape, colour, function, and all other information available about the objects should be communicated. Although it can be argued that the border between these two types has changed and converged, its influence is still seen. For instance, while the *Venus of Milo*, an object admired for its aesthetic value, has a prominent place in the room of the Louvre, the different types of utensils of a local Medieval town are crammed in one little showcase. Nonetheless, all objects bear content and knowledge that is valuable to communicate. It depends on the museums' goals which content (for instance rarity, historical value, quality, emotional connection, prominence) is most valuable to communicate. This will influence how digital devices will be of value in transferring this content as the knowledge is the commodity that is transferred and the objects are materialised parts of this knowledge.[12]

Archaeological museums are facing issues. They want preserve the past, because archaeological artefacts are defined as valuable for people as they are legacies of the past and ".. expressions (..) to our sense of belonging, of order and continuity, and of our collective meaning in the world.."[13], as embodiments of beliefs, attitudes and values[14], and as ".. a vital elements in creating social awareness and cohesion ..".[15] Digital devices can help museums in transferring the aesthetic, historical or emotional value of objects to the public. The devices can even broaden this transfer to a sensory or emotional experience in which the public is overwhelmed by buttons, lights, touchable items or immersive simulators. It can also be complementary as a multilayered pedagogical approach in which the visitor can view different perspectives while walking through an exhibition. For example, in the international exhibition *Keys to Rome*, visitors could pick different 'key-cards' in the Allard Pierson Museum to choose one of the three different perspectives to walk through the exhibition.[16] However, is the incorporation of digital technology in all cases legitimate to use to transfer the story of the objects? Do the benefits outweigh the disadvantages of technology or is the use of technology a result of other aims? And are digital reconstruction technologies still just devices to transfer content or has content become a side issue against the pressing attention of broadening the experience of the visitor? Because this is a recent development, academia and archaeological museums have not been able to answer all these questions. However, it must be stated here that museums, in general, should acknowledge that there are many questions and that these cannot be answered yet.[17] For example, it will be recognized in this study that the

[12] Hopper-Greenhill, *Museums and the Shaping of Knowledge*, 2.
[13] Smith, Messenger, and Soderland, *Heritage Values in Contemporary Society*, 15.
[14] Hooper-Greenhill, *Museums and the Interpretation of Visual Culture*, 23.
[15] Cleere, *Archaeological Heritage Management in the Modern World*, 6.
[16] Milar, *Het Museum 2.0*, 37.
[17] Angus Mol, Interview, executed 27 September, 2019; See also chapter 2.4.

communication between the museums and technical partners is not well connected yet and it appears to be a problem still today.

Although it has been generally stated that digital reconstruction technologies like 3D printing are a considerable low-cost solution and supplement to exhibition practices, a critical analysis has to be done to demonstrate if the benefits indeed outweigh the costs of this modern technology. For this reason, the following research question has been composed: How can digital reconstruction techniques and devices be of added value to the transfer of the meaning and content of archaeological objects in archaeological museums? Added value is defined here as the evidence to add something new to old practices and which is in general valuated as beneficial.

To detect the added value, a better understanding of reconstructions in archaeological museums, present digital reconstruction technology and digital technology as a device to transfer different types of information is needed. This study is, therefore, divided into three chapters. The first chapter will discuss the definition and history of reconstruction in archaeological museums. In this section, the following questions will be answered: What is meant by reconstructing? How were reconstructions used through time in archaeological museums? What are important aspects when museums reconstruct the past? What are the general considerations of Dutch archaeological museums to incorporate digital reconstruction devices? The second chapter will cover the first case study. In this case study, the following questions will be answered: Why is it needed for an archaeological museum to digitally reconstruct in general. How did museums transfer information with early immersive digital technology? And lastly, how and for whom was this of added value? The third chapter will cover the second case study. In this case study, the following questions will be answered: Why is it needed for an archaeological museum to reconstruct cultural heritage that is destroyed? How and with which reasons do museums recently transfer information with digital technology? And lastly, how has this changed through time in relation to the added value of the previous case study? It will be examined that authenticity is a key concept in this study. Moreover, it is viewed that authenticity is also the origin to much controversy in the discussion about the use of digital technology in archaeological museums. This thesis will end with a summary of the key findings and some conluding remarks.

The current added value of digital reconstruction technology in the archaeological museum will be demonstrated through the use of two case studies: the Leiden National Museum of Antiquities with the exhibition *Nineveh - The Great City* and the Allard Pierson Museum with the exhibition *Etruscans. Eminent Woman, Powerful Men*. In 2017-2018, the Museum of Antiquities in Leiden held the temporal blockbuster exhibition *Nineveh - The Great*

City[18] about the Assyrian city of Nineveh. The remains of the ancient city are situated in modern Iraqi, partly covered by the city of Mosul. In the exhibition, RMO showed several reconstructions of parts of the archaeological site that were made and presented by different kinds of technologies and devices. This included two reconstructed computer animations of the Assyrian city on screens through the exhibition space, two 3D printed reproductions of a bas-relief, the reconstruction of a room in the Southwest Palace and replicated winged lion sculptures. The exhibition gave special attention to the value of world heritage, the preservation of the past for the future and the recent destruction of heritage in crisis situations like the terrorist attacks in Iraqi. The Etruscanning-project was focused on the Regolini-Galassi Tomb, an Etruscan grave of a princess which is situated in Cerveteri. The project was part of an international cultural cooperation project between Italy, Belgium, Germany and The Netherlands and was performed by a diverse team of professions including curators, archaeologists and digital and artistic specialists.[19] A Virtual Reality application was temporally installed in the Allard Pierson Museum in Amsterdam on October 13 in 2011.

Methodology

The study is set up as an inductive research, because no applicable theories about added value were found in this field of research. This means that the study will analyse the facts, processes and opinions about digital reconstruction technology in the archaeological museum sector rather than test it against a certain theory.

The establishment of the research design was preceded by two short exploratory conversations with Lucas Petit, a curator of the Leiden National Museum of Antiquities and Tijm Lanjouw, a member of the 4D Research Lab in Amsterdam along with a literature study. This was done to form a deeper understanding of the problematics with the use of digital technology in archaeological museums. No clear problematics were visible at first, but through the discussions and a deep literature review, some critical elements came forward, which can be seen in the definition of the problem and the research question. This proved that only literature study alone was not enough to cover the extend of the issue and for that reason interviews were included in the study to gain more nuanced results.

This study is based on a qualitative research method. This method is chosen, because it fits better with the process of mapping added value of digital technology for a museum. Within the qualitative method, desk research and field research have both been chosen to

[18] Dutch version: Ninevé, Hoofdstad van een Wereldrijk.

[19] "Gregorian Etruscan Museum," Musei Vaticani, accessed June 23, 2019, http://www.museivaticani.va/content/museivaticani/en/collezioni/musei/museo-gregoriano-etrusco/sala-xvi--antiquarium-romanum--lucerne-e-stucchi/installazione-multimediale-interattiva-etruscanning.html

produce a different set of data. The inclusion of both desk research and field research will increase the validity of this research. The desk research will include the analysis of academic literature relating to the case studies and official documents published by the museums. The field research comprises of interviews with the curators of the museum involved. This data will be compared to critical reviews and academic reference works. Furthermore, interviews will be conducted with individuals who were not directly connected to the museum, but were part of the process of creating the exhibition and have knowledge of the used digital devices. It was during the interviews and the comparing of the case studies afterwards that new insights were gained which sharpened the attention of this thesis. The interviews revealed tensions that are still present today and undefined expectations between the different parties involved.

The selected case studies are Dutch examples. Therefore, an overview of the current professional expectations and general experiences with digital technology and digital devices in Dutch archaeological museums was created. Structured questionnaires were sent to several Dutch archaeological museums, and two museum responded.[20] The responding museums included a small and a large archaeological museum. The data is analysed in the first chapter and was used to contextualise the case studies. This will further increase the validity of this study.

The interviews with the curators are semi-structured and make use of indept-questionnaires. Most questions were devised before the interview, however, a semi-structured interview method makes a more in depth conversation possible. This resulted in a questionnaire that had both simple and focused questions about the matter. The focused interview has been used before in museums studies, although they were mainly focused on visitors instead of curators or museum professionals.[21] However, certain aspects of the focused interview are also very usefull in this study. The situation is already analysed beforehand and hypotheses are expected. The third and fourth step of focused interview provides the interviewer with a pre-imagened focus on non-objective opinions of the interviewees that are exposed to a situation that can be analysed later "..in an effort to ascertain their definitions of the situation."[22] The use of focused questions reveal underlying tensions and opinions that can be compared to the opinions in the general literature. Although certain preconceptions can be made about the opinions of the participants of the interview due to foreknowledge, an objective and open-minded position has been taken during the conversation to include all new insights. The inteviewees are museum professionals from different organisations, which has caused a difference in questions in the interviews. The

[20] Archeologisch Museum Haarlem & Museum Het Valkhof.
[21] Roppola, *Designing for the Museum Visitor Experience*, 70.
[22] Merton, Fiske and Kendall, *The Focused Interview*, 3.

interviews were carried out on the location of the museums of the two case studies (Amsterdam and Leiden) or online via e-mail contact.

To conduct the first case study, two professionals were interviewed. Firstly, Wim Hupperetz, who is the director of the Allard Pierson Museum and initiator of the Etruscanning project, and secondly Patricia Lulof; director of the Archaeological master and research master at the University of Amsterdam and director of the 4D Research Lab, who was involved in the development of the project. The interviews were executed and written out in Dutch. When referring to the interview, English translations will be used.

As the project has been developed in 2010 / 2011, it could be considered outdated in the light of the fast developments within the technological field. Both the Kinect sensor and the natural interaction for example are hardly used currently as it is replaced by Augmented Reality technology. It is therefore necessary to place the project in the context of the early incorporation and experimentation of high-tech visualisations in archaeological museums. It is however interesting to compare an early example of a digital reconstruction project with a more recent example like the Nineveh exhibition. This will emphasize possible differences between the museums' approaches along with elucidating practical discussions about the technology. Besides, it will place the projects within a bigger museum development.

The evaluation of the project is observed in several articles. The first version of the application, in the Allard Pierson Museum, was specifically evaluated by Christie Ray in order to improve the application for further versions.[23] The general development and evaluation of the project in the Archeovirtual exhibition is presented in an article of Pietroni, Pagano and Rufa.[24]

For the second case study, two different professionals were interviewed: Lucas Petit, archaeologist, curator of the collection Ancient Near East at the NMA and supervisor of the exhibition; and Angus Mol, University Lecturer at Leiden University and co-founder of the VALUE Foundation, who was involved before and during the display of the exhibition for the benefit of Prins Claus Fonds. The interviews were conducted in Dutch as well as written out in Dutch. When referring to the interview, translations into English will be used. In-dept questions were not possible with Petit, because he was abroad during the period of this study. Consequently, no deepening questions could be asked to Petit during or after the interview, because it was conducted via e-mail.

[23] Hupperetz, Pietroni, Pletinckx, Ray (ed.), and Sannibale, *Etruscanning.*
[24] Pietroni, Pagano and Rufa, "The Etruscanning Project."

The exhibition was quite recently (2017-2018), and was not specifically initiated as a project for experimenting with new ways of presenting archaeological material unlike the Etruscanning project. For these reasons, not much evaluating articles have been published thus far that reflect the opinion of the visitors about the exhibition and the technologies. The exhibition is, however, reviewed several times in the media; it is evaluated in their annual reports and can be compared with the results from the Etruscanning.

This research is relevant as a critical analysis of the use of digital reconstruction technology in archaeological museums and whether it is complementary to their communicative and educational practices. Although it has already been recognized that digital technology is complementary to museum practices in general, no in-dept research has been conducted specifically into the added value of digital reconstruction devices in the archaeological museum and the problems that evolve out of these assumed values.

Chapter 1: Reconstructing the Past

The reconstruction of the past is an inevitable part in archaeological museums of today. Advanced techniques and new media are used to communicate stories of past cultures to an audience. But what is meant by reconstructing the past and why is it deemed to be necessary for archaeological museums? To answer this question, a closer look at the history of the archaeological museum and their reconstruction practices is needed.

A long-term problem for the archaeological museum is that archaeological artefacts are vulnerable in many ways. Archaeological excavations results mostly in the destruction of the site to reach all the levels of occupation in the past.[25] During the excavation, objects can unintentionally be damaged or seen as less important. After the excavation, objects need to be maintained, especially with organic materials like wood or fibres, in order to preserve them.[26] When objects end up in the soil, it depends on the surrounding material and the climate how the objects will be affected and under what conditions they can survive in the ground.[27] The process of degradation and alteration accelerates when vulnerable objects are dug up.[28] Also in museums, the fragmented objects are still vulnerable and need to be carefully conserved to preserve them. After a war in the area, archaeological sites or monuments can be affected, attacked or looted by the several parties involved in the conflict. This has recently been brought to the attention of the bigger audience with the attacks on cultural heritage by ISIS in Syria and Iraq. Agriculture, construction work or the sewer also affect archaeological objects that are still in the soil.[29]

Archaeological museums were in their early development even destroyers and looters themselves.[30] The provenance of archaeological objects was not an important concern in early museological collecting.[31] Museums used collectors and dealers who had no interest in the background of objects, rather the aesthetical properties, to fill their archaeological collections. Bernard Eugéne Antoine Rottiers, a soldier with in interest in antiquities, sold for instance his

[25] Ewen, *Artifacts*, 20, 23.
[26] SIKB, *Eerste Hulp bij Kwetsbaar Vondstmateriaal*.; Ewen, *Artifacts*, 19, 25.
[27] Renfrew and Bahn, *Archaeology - Theories, Methods and Practice*, 55-72.; High, Milner, Panter, Demarchi and Penkman, “Lessons from Star Carr on the Vulnerability of Organic Archaeological Remains to Environmental Change.” ; Kibblewhite, Tóth and Hermann, “Predicting the Preservation of Cultural Artefacts and Buried Materials in Soil.”
[28] SIKB, *Eerste Hulp bij Kwetsbaar Vondstmateriaal*. Lorrain, Savoye, Chauvaud, Paulet and Naulet, “Decarbonation and Preservation Method for the Analysis of Organic C and N Contents and Stable Isotope Ratios of Low-carbonted Suspended Particulte Material.”
[29] Renfrew and Bahn, *Archaeology - Theories, Methods and Practice*, 549-551.
[30] Ibid., 541-542.
[31] Provenance refers to the entire history of an object, provenience only refers to the location where the object is found: Brody, *Unprovienienced Archaeological Collections in Museums*, 3.

collections of antiquities to the RMO, although his practices were not always trustworthy.[32] This changed during the 1960's when lack of contextual information of unprovenienced archaeological collections became more apparent to the public along with the looting and vandalism of archaeological sites.[33] Although policies about illegal excavations and illicit sale of antiquities are adopted, these practices still happens in the present and it has been argued that museums and the specialised academic community are failing to communicate about this.[34] The effect of decades of looting through imperialistic practices are to be seen partially in restitution claims.

New methods are constantly developed to upgrade archaeological fieldwork and the protection of archaeology, but the archaeological record is not infinite. The field of archaeology is, however, not able to stop their activities, because construction work, agriculture, terrorism attacking archaeology and the natural process of degradation will always be present.[35] To still present and protect archaeological material, archaeological museums are always searching for solutions in answer to this long-term problem. Therefore, among other things, reconstructions are being made to visualise past stories.

While the archaeological record is being damaged, destroyed, affected or at risk, the physical reproduction and reconstruction of archaeological material becomes more and more relevant to archaeological museums. The value of reconstructions was already known during the development of early archaeological museums.

First, a clear definition of 'reconstruction' is needed to make clear what is meant with this term in this study. Reconstructing is quite a general concept and should not be confused with the terms 'copy' or 'reproduction', although they are linked. The term *reconstructing* has been generally described as ".. the process of building or creating something again that has been damaged or destroyed (..) an attempt to get a complete description of an event using the information available, or an attempt to repeat what happened during the event..".[36] It should be noted that reconstructions and reproductions are not the same concepts. Reconstructions, as is described above, are made of parts of information about human actions or material culture that is damaged, destroyed or missing while reproductions, or replicas, are exact

[32] "Bernard Eugéne Antoine Rottiers (1771-1857)," RMO, accessed October 15, 2019, https://www.rmo.nl/museumkennis/geschiedenis-en-collectie/bernard-eugene-antoine-rottiers-1771-1857/.
[33] Brody, *Unprovienienced Archaeological Collections in Museums*, 3-4.
[34] Unesco adopted for instance in 1970 the *Convention on the Means of Prohibiting aand Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property* : Brodie and Renfrew, "Looting and the World's Archaeological Heritage," 344.
[35] Renfrew and Bahn, *Archaeology - Theories, Methods and Practice*, 565- 568.
[36] "Reconstruction," Cambridge Dictionary (online), updated 2019, https://dictionary.cambridge.org/dictionary/english/reconstruction.

copies of existing originals.[37] A reconstruction could never be a copy, because of missing information that will produce an interpretation of the original rather than a copy of it. However, a copy could be a reconstruction, because all information that is needed to reconstruct is available. Translating this term eventually to the science of archaeology, it can be described as the act to trace back, interpret and document human activities in the past by the study of the archaeological material culture that is available.[38] Besides, to cover the concept of authenticity as will be explained later in this study, the creation of an authentic reconstruction is hence not only obligated to present the original material, but also to produce an accurate context and reveal the object's function and development through time.

The documentation of human activities can be written or physically made, but with current technological devices the documentation and visulisation can also be digitally produced. The archaeological remains of a site are however mostly fragmented and therefore difficult to define. Because of this, reconstructions are, most of the time, interpretations rather than exact copies. While the dichotomy between reproduction and reconstructions is not a significant concern in early archaeological museums, it is relevant for current archaeological museums as will be examined in this study.

1.1 Reconstructions in early archaeological museums

As an institution responsible for communicating and exhibiting the tangible and intangible heritage of humanity, it can be argued that archaeological museums are responsible for visualising the interpreted human activities and its material culture on the best way possible with the knowledge, techniques and materials that are available. Since the beginning of their foundation, archaeological museums were the communicational force between archaeological information and society.[39] It will be demonstrated here that reconstructions have played an important role in this process.

1.1.1 Reconstructions as part of education and research

In their essencen archaeological museums were educational institutions that, in their nineteenth-century design, solely transported knowledge through the classification and organised displaying of its objects.[40] Museum objects formed research, study and teaching collections for the study of nature like medicine, geology or botany, and the study of human

[37] "Reproduction," Dictionary.com (online), updated 2019, https://www.dictionary.com/browse/reproduction.
[38] Binford, Cherry, and Torrence, *In Pursuit of the Past*, 19-20.
[39] Barker, "Exhibiting Archaeology: Archaeology and Museums," 294.
[40] Hooper-Greenhill, *Museums and the Interpretation of Visual Culture*, 5-6,126-128. A clear example of this can be seen at the Petrie Museum: MacDonald, "University Museums and the Public."

past and present behaviour.[41] Many early examples of archaeological museums were established in co-operation with a university. For example, the Ashmolean Museum as one of the oldest archaeological museums, founded in 1683, has always been connected to the University of Oxford.[42] The establishment of the Museum of Antiquities in 1818 was led by Caspar Reuvens, an extraordinary professor in Archaeology at Leiden University.[43]

Being object-based learning material was the central task of these collections. Reconstructed objects, like architectural and mechanical models, were an integral part of early collections and did for that reason probably also bear educational value.[44] Plaster replicas of ancient sculptures, so-called plaster casts, are also a well-known example of this.[45] Replicas of famous Greek and Roman statues and Italian Renaissance sculptures were studied and admired and treated with the same respect as the originals as they were representations of the original objects, was stated by Henry Watson Kent, Slater Memorial Museum first curator.[46] The making and using of copies was not an improper activity since Roman times as there were no clear objections against non-originals in comparison to today.[47] Reproductions were also used by museum for the purpose of teaching. The Ashmolean for instance owned a cast collection since 1884 for the teaching of Classical Archaeology at the University of Oxford.[48]

The value of learning through reproduction was already practised in the seventeenth century next to first-hand observation. Schools of 'beau arts' taught their students through observation and imitation similar to the owners of curiosity cabinets which used working models to show "..human ingenuity.." to all who were interested.[49] Medical practitioners also learned through practice, imitation and observation.[50] Replication and experimentation with models continued in the nineteenth century for the production of knowledge and for scientific explorations.[51] Eventually, replicated objects appeared in museums collections, be it by

[41] Lourenço, *Between Two Worlds*, 54-63. MacDonald, "University Museums and the Public," 68.
[42] Lourenço, *Between Two Worlds*, 49; "Home," Ashmolean, accessed October 5, 2019, https://www.ashmolean.org/.
[43] "Rijksmuseum van Oudheden: Geschiedenis Collectie," RMO, accessed September 23, 2019, https://www.rmo.nl/museumkennis/geschiedenis-en-collectie/rijksmuseum-van-oudheden/.
[44] Models were already used in Kunstkammers and curiosity cabinets for educational reasons: Dreier, "The *Kunstkammer* of the Hessian Landgraves in Kassel," 108; Theuerkauff, "The Brandenburg *Kunstkammer* in Berlin," 111; Lightbown, "Some Notes on Spanish Baroque Collectors," 137.
[45] Plaster casts are mostly plaster replicas of sculptures from classical antiquity and Italian renaissance, but can also include replicas of ancient architecture, reproduced gems, ivories: Frederiksen and Marchand, *Plaster Casts*; Baker, "The Reproductive Continuum."
[46] Wallach, *Exhibiting Contradictions*, 41.
[47] Lowenthal, *The Past is a Foreign Country - Revisited*, 449.
[48] "Cast Gallery," Ashmolean, accessed September 7, 2019, https://www.ashmolean.org/cast-gallery-2.
[49] Lourenço, *Between Two Worlds*, 56. ; Lock, "Picturing the Use and Display of Plaster Casts in Seventheenth- and Eighteenth Century Artists' Studios in Antwerp and Brussels."; Isaac, "Whose Idea Was This? Museums, Replicas, and the Reproduction of Knowlegde," 213.
[50] Swan, "Making Sense of Medical Collections in Early Modern Holland," 201.
[51] Isaac, "Whose Idea Was This? Museums, Replicas, and the Reproduction of Knowlegde," 213-214.

donation or acquisition. Both natural and art museums displayed ".. reproductions, maquettes, and pedagogical models" next to original objects to supplement their displays.[52] Besides, they became helpful research tools for the study of the originals as is seen with for instance gems which were sometimes hard to study due to the translucency of the material.[53]

In the 18th and early 19th century, collection-based research increased and museum and university collections expanded due to scientific advancements. This started a change in the meaning-making of the artefact. The object became ".. a document, a tool for the systematic understanding of the *other* (..) in time..".[54] Objects, and also reconstructions as is seen with the plaster casts, could be researched and studied for its historical value along with its aesthethical value. The study could both be for personal reasons and professional reasons; Sir John Soane, founder of Sir John Soane's Museum London, architect and Professor of Architecture at the Royal Acadamy, was a known European collector of plaster casts since the 1790s and 1800s. He bought plaster casts for his teaching in architecure, he ordered plaster casts to decorate his architectural creations and he collected plaster casts for his personal collection in his gallery (now the Dome Area of the Soane Museum).[55]

Besides, commissioning replicas was not an unusual practice for an archaeological museum as is seen in the case of the Pitt Rivers Museum, who assigned Fred Snare, a known reproducer of flint knapping, to deliver stone tools.[56] The South Kensington Museum commissioned and produced reproductions themselves. This included reproductions of stained glass, mosaics, electrotypes, ancient statues, paintings.[57] The production of replicas, reconstructions and casts for research and study purposes continued after the nineteenth century, although with a slight reduction in the beginning of the twentieth century due to discussion about the value of them. However, in the early practice of archaeology, reproductions were still valued for research purposes.[58] Especially during the development of experimental archaeology in the second half of the nineteenth century, copies became valuable as items on their own.[59] Although, the concept of the copy as a representation of the original is vividly discussed in postmodern philosophy, its appearance, fusion and specific function into archaeological museum collections has, unfortunately, not been a much discussed topic.

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[52] Lourenço, *Between Two Worlds*, 56.
[53] Wagner and Seidmann, "A Munificent Gift."
[54] Lourenço, *Between Two Worlds*, 66-67.
[55] Dorey, "Sir John Soane's Casts as Part of his Academy of Architecture at 13 Lincoln's Inn Fields," 598-599; "Our History," Sir John Soan's Museum London, accessed October 18, 2019, https://www.soane.org/about/our-history.
[56] Isaac, "Whose Idea Was This? Museums, Replicas, and the Reproduction of Knowlegde," 215.
[57] Baker, "The Reproductive Continuum," 490-494.
[58] Kamph, *Examining Commodity, Agency, and Value*, 5.
[59] Flores and Paardekooper, *Experiments Pasts*, 8.

1.1.2 Reconstructions for presentation

As reconstructions were adopted into museum collections, their value for displaying the past became visible in archaeological museums. Through the scientific advancements in the 19th and 20th century, the rise of disciplines like anthropology and art history and as the materiality of objects served as the confirmation of evidence, archaeological museums feld obligated to widen their collections.[60]

Figure 1.1: Architectural model, made in 1780 of cork.

The first models of ancient architecture were constructed in the 1760s in cork and wood (fig. 1.1).[61] The models were meant for educational purposes as well as devices to transfer "..the real and ideal grandeur of antiquity", the physical monumentality of ancient architecture in miniature in museums.[62] The development of the miniature models also started the evolvement of a canon of Roman architecture in all its forms and functions. By the 1780s, white plaster models appeared, which showed both the transience of the buildings and the classical idea they represented.[63] Likewise, plaster casts were also appreciated as models for didactic purposes in the museum as well as appreciated for the values and beliefs that lay behind the statues; values and beliefs that started the first museums in Europe and were seen as the foundations of traditional learning and aesthetic taste.[64] A complete collection by the use of replicas made it possible for museums to shape a history of art with roots to classical antiquity and Italian renaissance and have their own canon of ancient art, something that was not possible by only using original objects.

Figure 1.2: Part of an ancient temple in real size in the Académie des Beaux-Art, Paris.

[60] Lourenço, *Between Two Worlds*, 66-67; Brody, *Unprovienienced Archaeological Collections in Museums*, 4.
[61] Kockel, "Plaster Models and Plaster Casts of Classical Architecture and its Decoration," 420.
[62] Ibid., 422.
[63] Ibid., 423-424.
[64] Wallach, *Exhibiting Contradictions*, 48. Baker, "The Reproductive Continuum," 485.

Systematic collections of plaster casts and models appeared in the early nineteenth century.[65] Moreover, entire sections of temples, in real size or almost real size, were reproduced to show the physical monumentality of ancient architecture in the museum (fig. 1.2)."[66] A mutual agreement of the value of casts and reproductions was acknowledged in 1867 with the *International Convention for Promoting Universal Reproductions of Works of Art*.[67]

However, at the early beginning of the twentieth century although the first critiques were already visible in the late nineteenth century, the value of copies changed.[68] This was caused by several reasons. The casts collections faded away from art collections due to the expansion of the European art market and professionalised connoisseurship.[69] The concepts of originality and authenticity were introduced as important values for objects in all museums wherein copies and casts were condemned as "..worthless.." and "..second-rate..".[70] This discussion was however not new as the philosophical concept of authentic versus copy was already discussed in the Enlightenment.[71] "The presence of the original is the prerequisite to the concept of authenticity" as was claimed by Walter Benjamin in 1935, reviewing artworks in the "Age of Mechanical Reproduction".[72] Moreover, it was noticed that the process of reproduction could damage the originals.[73]

These arguments led to a large discussion about cast collections in general and to the removal of the casts from the museum displays. Some museums, like the South Kensington Museum (now Victoria and Albert Museum), still displayed casts next to originals, although their opinions towards the casts was more directed to the education purpose of the reproductions instead of the purpose of display and wonder.[74] A renewal in interest around the mid and late twentieth century reintroduced casts into museums both for education and display.[75]

1.2 Contemporary reconstruction devices in museums and their problematics

[65] Kockel, "Plaster Models and Plaster Casts of Classical Architecture and its Decoration," 423-424.
[66] Ibid., 420.
[67] Bilbey and Trusted, " "The Question of Casts"," 466.
[68] Mixed feelings about reproductions in the museum was already expressed in 1862 by John Charles Robinson, curator and art referee of the South Kensington Museum (now called Victoria and Albert Museum): Bilbey and Trusted, " "The Question of Casts"," 466.
[69] Wallach, *Exhibiting Contradictions*, 50; Dyson, "Cast Collection in the United States," 572-575.
[70] Bilbey and Trusted, " "The Question of Casts"," 468.
[71] Isaac, "Whose Idea Was This? Museums, Replicas, and the Reproduction of Knowlegde," 211-212.
[72] Benjamin, Arendt, and Zohn, *The Work of Art in the Age of Mechanical Reproduction*, 3.
[73] Bilbey and Trusted, " "The Question of Casts"," 469.
[74] Ibid. 473.
[75] Bilbey and Trusted, " "The Question of Casts"," 481. Menegazzi, "The Museum as a Manifesto of Taste and Ideology, "624.

The fast-developing techniques and resources of today make museums able to perform admirable results with convincing real-life like models and multisensory experiences to reproduce and reconstruct past stories and archaeological sites. Different concepts of reality are examined to levels that could not be reached until recently. Digital technology - especially laser scanning and photogrammetry - has developed rapidly since the beginning of the twenty-first century. This has resulted in several reconstruction devices like Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR) and 3D printing. Museums can make reconstructions themselves or they can produce it in co-operation with specialised organisations. However, the added value of these technologies in archaeological museums are partially scattered over many isolated projects whereby the added value is not specifically defined and thoroughly discussed. More in-dept background information about laser scanning and photogrammetry and the use of Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR) and 3D printing in museums are further elaborated in Appendix 1.

Museums have already experimented with numerous reconstruction devices as they would be complementary to their usual practices.[76] General motivations for present-day archaeological museums can be identified; the ability to recreate and enliven archaeological material that is destroyed, to broaden the experience of the visitor, to increase the accessibility of the museum for disabled people, to make their displays more interactive and attractive for especially young visitors, the reconstruction of heritage, to experience new ways of presenting knowledge and conservational reasons. AR, MR and 3D printing are acknowledged as most suitable for exhibition enhancement.[77] For instance, in the Bone Hall in the Smithsonian's National Museum of Natural History, AR made it possible to combine an old-fashioned exhibition with modern technology by projecting 3D 'dressed' interpretations onto the skeletons in an app.[78] The dressed interpretations appear when the skeleton is detected, creating an inseparable relation between the original object and the technology. This examines why AR is more useful than VR as it combines the real world with the digital world while VR is fully digital.[79] Additionally, 3D printing was used by museums in Tuscany to enhance the experience of the visitor by incorporating more senses into the display.[80] With the use of 3D printed archaeological objects, the items could be directly touched.

[76] The adoption of VR in cultural heritage projects started around 1989, but became popular through the development of the Oculus Rift in 2012, the use of AR in CH projects started in 2001: Bekele, Pierdicca, Frontoni, Malinverni and Gain, "A Survey of Augmented Reality, Virtual, and Mixed Reality for Cultural Heritage," 4.
[77] Bekele, Pierdicca, Frontoni, Malinverni and Gain, "A Survey of Augmented Reality, Virtual, and Mixed Reality for Cultural Heritage," 19; Wilson, Stott, Warnett, Attridge, Smith and Williams, "Evaluation of Touchable 3D-Printed Replicas in Museums."
[78] Marques and Costello, "Skin & Bones: An Artistic Repair of a Science Exhibition by a Mobile App."
[79] Marques and Costello, "Concerns and Challenges Developing Mobile Augmented Reality Experiences for Museum Exhibitions," 552.
[80] Puma, "The Digital Cultural Heritage-Digitch Programme," 159-162.

It has been identified that many devices are incorporated in the museum for the purpose of the experience of the visitor. Research resulted in the argument that installations in a museum are observed as less interesting to visitors when not introducing new technologies or devices while interactive and immersive displays and intelligent spaces are interesting for visitors and can create newly layered experiences.[81] These widening experiences are mostly focused on cultural conditions; the understanding of the cultural contexts in which artefacts were present.[82]

Furthermore, these techniques certainly have disadvantages. There is still scepticism seen against digital technology in museums. Concerns have been expressed against the efficiency of AR[83], the unauthenticity of 3D printing[84] and hostility against the use of new media[85]. Marques and Costello have tried to sum up some concerns and challenges about AR but most can also be applied to all devices that use digital visualisation like VR and MR.[86] They argue, however, that some concerns are based on anecdotes and assumptions and are therefore no valid concerns.[87] Concerns they do have are that novel and interesting technology can be distracting and can focus all the attention onto the technology itself. Gimmickry, described as a trick to make a product more successful by using gimmicks, has been recognized in combination with AR, although this could also be said for VR, MR or holography. It has been feared that technology will detract visitors from their surroundings; the exhibition. The study in the Royal Museum of Art and History revealed that caution must be taken in terms of physical surroundings and objects in the room where AR is conducted to prevent the falling down of objects through inattentiveness of visitors.[88] The technology could lead to risks concerning the fragility of the material and to a more commercial and visitor-centred vision, turning the museums into amusement parks.[89] It must be noticed that archaeological museums are aware of this phenomenon and are generally cautious with the use of digital technology in their exhibition as they are both institutions for amusement and for the

[81] Bekele, Pierdicca, Frontoni, Malinverni and Gain, "A Survey of Augmented Reality, Virtual, and Mixed Reality for Cultural Heritage," 16; Manovich, "The poetics of Augmented Space," 219. Chang, Chang, Hou, Sung, Chao and Lee, "Development and Behavoiral Pattern Analysis of a Mobile Guide System with Augmented Realtiy for Painting Appreciation Instruction in an Art Museum."
[82] Choi, "The Conjugation Method of Augmented Reality in Museum Exhibition," 220.
[83] Marques and Costello, "Concerns and Challenges Developing Mobile Augmented Reality Experiences for Museum Exhibitions," 541.
[84] Wilson, Stott, Warnett, Attridge, Smith and Williams, "Evaluation of Touchable 3D-Printed Replicas in Museums."
[85] Henning, *The International Handbooks of Museum Studies 3: Museum Media*, 302.
[86] Marques and Costello, "Concerns and Challenges Developing Mobile Augmented Reality Experiences for Museum Exhibitions," 541-558.
[87] Ibid., 541.
[88] Nofal, Elhanafi, Hameeuw, and Van de Moere, "Architectural Contextualization of Heritage Museum Artifacts using Augmented Reality," 59-60.
[89] Ballantyne and Uzzell, "Looking Back and Looking Forward," 88.

production of knowledge. However, when incorporating digital technology into the exhibition, the border between being a useful device and being a distraction is less apparent, as will be viewed in the case studies. Besides, an evaluation study for 3D printed models in the Oxford University Museum of Natural History showed that the models did not necessarily encourage visitors to visit the museum more often.[90] Gimmickry should never be the beginning of an idea to incorporate digital devices into an exhibition, but careful thinking about the concrete value of the device for the exhibition should be considered to meet with the demands of the visitors and the demands of the collection.

Another concern that has been expressed not only with AR but with more digital technology is the unfamiliarity of the use of the devices for the visitor. This mostly depends on the age and experience with technology of the visitor.[91] Older people seem to appreciate AR less than younger people.[92] An unintentional effect of this results in a feeling that these technologies are intended for younger visitors although they are useful for all visitors. Yet, simplistic interaction and instructions contribute to creating more familiarity with the device, no matter what age and it can be assumed that more people will get used to the technology because it is a growing societal development.

Technical concerns have been noticed as most serious to bridge at the moment. The most important technical problems with AR are the amount of light in the room, the 'line of sight' which means the amount of distance a device needs to detect information, noise level and lastly internet access which is not always available through a limited amount of bandwidth.[93] Other challenges that are present with this technology are in the principles of co-localization, co-occlusion and co-lighting.[94] When the choice is made to use museum devices like iPads instead of visitors own mobile phones, queues will form on busy days causing impatience with the visitor to experience the AR tour. VR can cause motion sickness caused

[90] Wilson, Stott, Warnett, Attridge, and Smith, "Evaluation of Touchable 3D-Printed Replicas in Museums," 454.
[91] Marques and Costello, "Concerns and Challenges Developing Mobile Augmented Reality Experiences for Museum Exhibitions."; Wilson, Stott, Warnett, Attridge, and Smith, "Evaluation of Touchable 3D-Printed Replicas in Museums."; Nofal, Elhanafi, Hameeuw, and Van de Moere, "Architectural Contextualization of Heritage Museum Artifacts using Augmented Reality," 58
[92] Nofal, Elhanafi, Hameeuw, and Van de Moere, "Architectural Contextualization of Heritage Museum Artifacts using Augmented Reality," 57.
[93] Marques and Costello, "Concerns and Challenges Developing Mobile Augmented Reality Experiences for Museum Exhibitions."
[94] Co-localization is the correct alignment of reality with the virtual elements that are blended in by the use of computer vision techniques like GPS and depth cameras. Co-occlusion is the occlusion of the virtual elements into the geometry of reality by the use of scanners and depth cameras. Co-lighting is the rendering of light interaction between virtual and actual elements into the scene. Bentkowska-Kafel and MacDonald, *Digital Techniques for Documenting and Preserving Cultural Heritage*, 207-208.

by the latency between the movement of the head and the movement of the video on the screen.[95] Lastly, the resolution of the models can in some cases be considered simplistic.

Specific problems that show the limitations of a 3D printer is its inability to produce models with all types of materials, although this is rapidly changing. Limited repeatability has also been described as a limitation as the process of cooling and warping can cause variations between the models.[96] Besides, the impact of the use of plastics affects our health and environment, the printing requires a significant amount of energy, it causes unemployment as the machines absorb the need for humans by automatization and small limitations due to the infancy of the technology are still challenges to overcome.[97] In museums, 3D prints were received in some cases as not accurate, because of missing an authentic and realistic appearance.[98]

With all these new technologies, a new understanding of the physical museum and its value in a digitalised society, in which museums can even be virtually made, must be considered. As knowledge is recognized as the 'commodity' of museums, and objects are the materialised parts of knowledge, what is the influence of digitisation on the shaping of knowledge?[99] While it could be argued that the value of authentic objects may increase as they are more appreciated than inauthentic or digital objects, the digital objects could also increase in value as they contribute to rebuilding the past or re-contextualising objects. A shift is, for instance, already detected wherein digital devices use additional storytelling to present information in a multi-layered way.[100] This way plural stories can be presented causing a shift in thinking about the context surrounding an original object.

1.3 Authenticity and Modern Technology

To evaluate the added value of contemporary reconstructions, the concept of authenticity has to be further explained. When in some cases, the original object is no longer available through theft, destruction or impairment, authenticity is the remaining value which the museum must adhere to. Although the concepts of authenticity and originality are still applicable today in

[95] "Virtual Reality; Alles Wat Je Moet Weten," VR Expert, updated March 15, 2015, https://vr-expert.nl/blog/virtual-reality/.
[96] Redwood, Garret, and Schöffer, *The 3D Printing Handbook*, 9.
[97] "3D Printing Limitations," TT Consultants, updated December 14, 2017, http://ttconsultants.com/blog/3d-printing-limitations/.
[98] Wilson, Stott, Warnett, Attridge, and Smith, "Evaluation of Touchable 3D-Printed Replicas in Museums," 459.
[99] Hopper-Greenhill, *Museums and the Shaping of Knowledge*, 2.
[100] Rizvic, "How to Breathe Life into Cultural Heritage 3D Reconstruction."; Puma, "The Difital Cultural Heritage-Digitch Programme."; Patricia Lulof, Interview with author, 25 September, 2019.

museums and academic research, this does not completely exclude the production and use of non-original objects or interpretations.

Authenticity is in most cases defined with the words real, true and genuine and is opposite to fake and false.[101] It has to be "..worthy of acceptance or belief as conforming to or based on fact.." and "..conforming to an original so as to reproduce essential features..".[102] This means that a reconstruction made for the archaeological museum has to be real and true and based on the archaeological material culture that is found to give the public a credible experience of the past through understandable communication.

The tendency to the current strong urge of authenticity was a reaction against the mass production during the industrial revolution as is connected to the ideas of Walter Benjamin.[103] Through the returning appreciation for the artist and his 'visual powers' as a counter-reaction against the development of ritual art without specific artists names, a direct link between the object and its artist was needed to guarantee authenticity. This link was more encouraged by the further secularisation of society. This led to an abundance of the use of the concept wherein the concept became even connected to morality and authority and was uplifted to an irrational faith in the realness and conservational value of objects.[104] Authenticity has been divided into five categories, according to Nicole Ex, although four categories are the most interesting to capture: material authenticity, contextual and functional authenticity, a-historical authenticity and historical authenticity.[105] Material authenticity refers to the original material of the object. Contextual and functional authenticity is outlined by the object's function in time as, for instance, a saucepan was functional in the kitchen in ancient times, became unusable and thrown away and eventually changed to a museum piece in its new context with museological and aesthetic value. The a-historical authenticity refers to the condition in which the object was made, without the history of its use afterwards while historical incorporates the changed that has been made during the usage of the object.

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[101] "Authenticity," Cambridge Dictionary (online), updated 2019, https://dictionary.cambridge.org/dictionary/english/authenticity ; "Authenticity," Dictionary.com (online), updated 2019, https://www.dictionary.com/browse/authenticity ; "Authenticity," Vocabulary.com (online), accessed September 9, 2019, https://www.vocabulary.com/dictionary/authenticity ; Ex, *Zo Goed als Oud, De Achterkant van het Restaureren*, 21.

[102] "Authentic," Merriam-Webster, updated 2019, https://www.merriam-webster.com/dictionary/authentic.

[103] According to Ex since his essay on *Das Kunstwerk im Zeitalter seiner technischen Reproduzierbarkeit* (1938): Ex, *Zo Goed als Oud, De Achterkant van het Restaureren*, 93-95 ; Evans, Mull and Poling, "The Authentic Object? A Child's-Eye View," 55.

[104] Ex, *Zo Goed als Oud, De Achterkant van het Restaureren*, 94.

[105] This excludes conceptional authenticity. It should be noted that the author has based these catagories on art, although they could also be applicable to archaeology: Ex, *Zo Goed als Oud, De Achterkant van het Restaureren*, 91-129.

Authenticity is, thus, a multi-layered concept and the creation of an authentic reconstruction is hence not only obligated to present the original material, but also to produce an accurate context and reveal the object's function and development through time.

However, the advancement of digital technology causes a need for a more specified definition. Immersive technologies have enhanced the perception of reality which changes the way the different authenticities are perceived. A continuum, described by Milgram and Kishino in 1994, visualises these different realities.[106] The real world is in this continuum opposite to the virtual world with in between the immersive realities of augmented reality (AR), augmented virtuality (AV) and mixed reality (MR). Terms like 'real' and 'true' have changed to subjective aspects through this immersive development and therefore needed to be more thoroughly understood.

In general, it has been recognized in the past that the value of objects can change when they are a representation of reality, copies of the real objects. Museums, as an object-centred institution with material culture paradigms, are bound to the perspective that original material is superior to the digital immaterial.[107] At first, the digital object had been ascribed to be 'terrorist' to the authentic object as it could undermine the museum practices by subverting the values and meanings of the original object. However, this has been invalidated and re-interpreted by authors more recently.[108] Changing perceptions about the dichotomy between digital versus non-digital objects are still present in the recent discourse and should be further examined and better understood by academia and museum professionals.

By disengaging from the notion of the authentic epistemology that is naturally present in museums, objects can be re-evaluated by their content which is fluid and polysemic according to Hooper-Greenhill.[109] The object is in this case besides its materiality or use in the past also validated by its use and meaning in the present.[110] The terms 'real' and 'authentic' change through this broader perspective into more flexible concepts. For instance, a 3D printed object can have meaning when the original object is gone and can be used to visually represent the authentic object. The meaning of the authentic object is not directly transferred to the printed object but the new object can be valued as the opportunity to still show the missing object, creating a new recent layer of meaning onto the representation of the old

[106] Milgram and Kishino, "A Taxanomy of Mixed Reality Visual Displays," 2-4; Bekele, Pierdicca, Frontoni, and Malinverni, "A Survey of Augmented, Virtual, and Mixed Reality for Cultural Heritage," 3-4.
[107] Cameron, "Beyond the Cult of the Replicant," 49.
[108] Henning, *The International Handbooks of Museum Studies 3 Museum Media*, 307; Camaron, "Beyond the Cult of the Replicant," 49-75.
[109] Hooper-Greenhill, *Museums and the Interpretation of Visual Culture*.
[110] Thomas, *The Return of Curiosity*, 49-51; Appadurai, *The Social Life of Things: Commodities in Cultural Perspective*, 3.

object. This broader perspective of the object eventually changes the system of evaluating objects into a mutable system. It can therefore also incorporate representations of objects as these remain to represent the same history although they miss the same materiality. The functional and historical authenticity, described by Ex, is hence more preferred than the material authenticity. The latter consideration has encouraged the understanding of a digital model or printed model as a work on its own, rather than as only a copy of reality, and provides it with the appreciation of value.[111]

A bold, however important, question should be asked: Do museum visitors care? Clear evidence indicates that humans consider originals as extremely valuable.[112] Although the perception of authenticity, i.e. the realness of objects, differs per age, it is viewed that the authentic object arouses an awe-inspiring magical experience by the original materiality and history of the object.[113] Additionally, the knowledge, which argues that an object is original, is very influential. Critical questions should, however, be considered when printing techniques develop to high levels of realness. Could this awe-sense be misled when the 3D printed object is almost as real looking as the original object? And what if the original object is destroyed and the material authenticity is lost? The former consideration of a flexible authenticity is in this case very useful, providing the representation of the object with the value of the original. Besides, it was argued that, although reconstruction should not replace objects in their original form and setting, they can provide contextual information to enrich the experience and engagement in museums.[114] Especially in archaeological museum, when objects are fragmented or destroyed, this contextualisation of objects is valuable.

While the application of this flexible consideration could be efficiently used with objects, its application on more comprehensive archaeological material culture is less easy. An archaeological site typically changes more than one simple object, and more data can be lost with the use of a whole site than with one object.

There is a certain complex encounter in the discussion of authenticity in archaeological museums.[115] On the one hand, museums want to preserve the past and restore what has been lost. On the other hand, correct and authentic reconstruction of the material culture of human activities is desired to communicate its content for education, study and enjoyment as is defined in the Museum Definition of ICOM.[116] Objects are the embodiment of past and

[111] Camaron, “Beyond the Cult of the Replicant,” 54, 70.
[112] Saunderson, Cruickshank and Mc Sorley, “The Eyes Have It,” 90.
[113] Evans, Mull and Poling, “The Authentic Object? A Child’s-Eye View,” 75 ; Van Gerven, Land-Zandstra and Damsma, “Authenticity Matters,” 338.
[114] Frost, “When the Object is Digital,” 93.
[115] Lowenthal, *The Past is a Foreign Country - Revisited*, 413.
[116] The last version is adopted by the 22nd General Assembly in Vienna on 24 August, 2007: “A museum is a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and

present societies and museums are in this fashion the keepers and protectors of those representations of society. It is therefore the responsibility of the museum to strive at true and authentic reconstructions. However, many archaeological sites are affected whereby the margin of uncertainty arises and the level of correctness and authenticity differs. Examples of this can be viewed within every project that includes destroyed or damaged heritage and a poor registration of the site. However, it is not precisely known how archaeological museums are dealing with this issue, and how they should deal with this as will be presented in the case studies.

It will be concluded here that authenticity is a many-sided concept. To define the concept for this study, it will be viewed as a social construct with a particular aim.[117] This aim is to present the most important part of the object; its material aspect, its historical or a-historical, its contextual and functional or all three. For archaeological objects, this usually includes the historical and contextual/functional aspect of the object. Archaeological material culture can be affected or destroyed, reducing the material aspect, and usually changes over time in which the a-historical aspect is more uncertain.

The recognition of the value of digital objects in museums offers space for thought about the digital objects themselves. What is the added value of reconstructions for contemporary archaeological museums? Although the techniques make archaeological museums able to make convincing reconstructions, the fact continues that archaeological sites remain fragmented or affected and not all aspects of the reconstruction can thus be based on facts. How do museums respond to this conflicting body of choices? To answer this question, two Dutch case studies will be examined in the second (the Museum of Antiquities with the exhibition *Nineveh - The Great City)* and third chapter (the Allard Pierson Museum with the exhibition *Etruscans. Eminent Woman, Powerful Men*) of this study.

1.4 Dutch archaeological museums and reconstruction

The case studies in chapter two and three are Dutch examples. The Netherlands has several bigger and smaller archaeological museums. Most of these museums use digital technology in their museum practices. Therefore, an overview of the current professional expectations and general experiences with digital technology and digital devices in Dutch archaeological museums have to be made. Besides a literature review, structured questionnaires were sent to several Dutch archaeological museums, and two museums responded: Archeologisch

intangible heritage of humanity and its environment for the purposes of education, study and enjoyment" : "Museum Definition," ICOM, accessed July 2, 2019, https://icom.museum/en/activities/standards-guidelines/museum-definition/.

[117] MacNeil and Mak, "Constructions of Authenticity," 26.

Museum Haarlem & Museum Het Valkhof. Archeologisch Museum Haarlem is a small museum situated in Haarlem, Museum Het Valkhof is a large museum in Nijmegen.

The general opinion of Dutch archaeological museums about the value of reconstructing the past is mainly focused on communicating the story behind archaeological objects to the public.[118] Reconstruction, both analogue and digital, can help the museum to attractively and more visually present incomplete material culture. Besides, the museum visitor will perceive and understand the material in a more easy and fun way as a visual image often creates a more comprehensive experience than words only.

Especially digital reconstruction is currently popular to incorporate within the museum display as is seen with many Dutch archaeological museums. For instance, Archeologisch Museum Haarlem reconstructed, with the use of analogue and digital reconstruction devices, a human from the Middle Ages called 'Cornelis'.[119] Besides, they made a video about the history of the museum called *Haarlem in Vogelvlucht* (a spin around Haarlem).[120] Huis van Hilde uses films and multimedia presentations in their permanent exhibition to visualise the landscape, different periods in time and excavations. Additionally, children can search for treasures in an interactive virtual sandbox at the ArcheoGame.[121] Museum Het Valkhof re-uses digital reconstructions of past temporal exhibitions in their permanent exhibition like the reconstruction of the headquarters of a Roman army site, and a Roman market.[122] Moreover, in the exhibition *Gezichten van de Limes, de Romeinse Rijksgrens in Nederland* (September 2016 - March 2017), they used Google Maps to visualise the Roman Limes. [123] With the use of digital reconstruction technology, space-saving solutions can be produced to experience a historical setting which would usually take too much space, like monumental architecture or a development through time.[124]

Unfortunately, Dutch cultural policy has not been beneficial for museums, in general, the past few years. The combination of changing expectations of the public, the development

[118] Arch. Museum Haarlem, Questionnaire, received October, 2019 ; Museum Het Valkhof, Questionnaire, received October, 2019.
[119] Arch. Museum Haarlem, Questionnaire, received October, 2019 ; "Archief: Oog in oog met Cornelis; Gezicht op Middeleeuws Haarlem," Archeologisch Museum Haarlem, accessed October 22, 2019, https://www.archeologischmuseumhaarlem.nl/node/511.
[120] Haarlem Marketing, "Haarlem in vogelvlucht,"streamed on August 1, 2018, YouTube video, 6:19, https://www.youtube.com/watch?v=3k_0PSTd7hg.
[121] "Permanent: Ontdek de Archeologie van Noord-Holland," Huis van Hilde, accessed October 22, 2019, https://huisvanhilde.nl/tentoonstelling/vaste-tentoonstelling/ ; "Archeologiecentrum Huis van Hilde," Go-Kids, updated 2019, https://go-kids.nl/alkmaar/erop-uit/huis-van-hilde.
[122] Museum Het Valkhof, Questionnaire, received October, 2019.
[123] Museum Het Valkhof, "Tentoonstelling 'Gezichten van de Limes, de Romeinse Rijksgrens in Nederland' in Museum Het Valkhof."
[124] Arch. Museum Haarlem, Questionnaire, received October, 2019 ; Museum Het Valkhof, Questionnaire, received October, 2019.

of digital techniques and devices and the process of decreasing funds from the government have museums driven to optimise their practices by incorporating digital technology in its development.[125] Although Dutch museums had a rising visitor revenue (112 per cent between 2009 and 2016), they had less to spend due to decreasing grants from the government (a decline of 14 a 17 per cent between 2011 and 2016) and higher costs in staff and housing.[126] The exhibition costs of so-called blockbusters have also raised the costs of exhibition-making.[127]

The use of digital technology also plays a part in the raising of costs for making an exhibition. Although digital technology is perceived as useful and attractive to advertise, problematics with technology is mostly focused on the expenses.[128] The use of digital technology to reconstruct and digital devices to present digital applications or models or to print the data is still very expensive. Besides, the technology is fragile, requires maintenance, is vulnerable to technical failures and is quickly perceived as outdated, especially by the younger generation. The knowledge which is needed to use, maintain and update the digital devices is not always present within the museum, as is argued by the curator of the Archeologisch Museum Haarlem, and more expenses have to be made to hire professionals with the necessary knowledge.[129]

Thus, it is observed that besides scientific correctness, costs are also one of the main aspects that is incorporated into the process of deciding whether to include digital technology. The added value of the technology should outweigh the costs. When decided to incorporate digital technology, there are still questions which technology to use since there are many options with several purposes and advantages. De Hogeschool van Amsterdam has developed practical methods that help museum professionals to decide which digital technology to use to attract the visitor.[130] They used four returning questions that relate to the accomplishment of the goal: Who am I [the museum]? Which media strategy do I [the museum] use? Which possibilities do I [the museum] have to optimise the design in the exhibition, which fits with the standards of the public? Which indicators are present in exhibition design that could be evaluated to see if the implicit and explicit goals concerning the digital technology are achieved? The technology is currently regarded as useful in archaeological museums

[125] Museumkompass, “Een Samenvatting van de Resultaten van het Project Museumkompas 2011-2014,” 8 ; Van Vliet and Schrandt, “Kansen en Keuzestress,” 26-28.
[126] “Economie van de Sector, Governance en het Rijksgesubsidieerde Bestel,” Toekomst Cultuurbeleid , accessed September 18, 2019, https://toekomst-cultuurbeleid.cultuur.nl/sectoradviezen/musea/economie-van-de-sector-governance-en-het-rijksgesubsidieerde-bestel.
[127] Ibid.
[128] Arch. Museum Haarlem, Questionnaire, received October, 2019 ; Museum Het Valkhof, Questionnaire, received October, 2019.
[129] Arch. Museum Haarlem, Questionnaire, received October, 2019
[130] Van Vliet and Schrandt, “Kansen en Keuzestress.”

when it translates scientific conclusions to understandable information for the visitors; when it fits into the story that is told; and when it is balanced against the non-digital objects.

The financial climate has currently changed for museums as is seen in reports of the Museumvereniging, the national association for Dutch museums.[131] Cautious goals are proposed in their annual plan for 2019 to encourage public interest by the use of wonder, connection, development, experience and enrichment.[132] Unfortunately, it is not sure whether digital technology is actually expected in a museum by the visitors as there have been no or almost no research or evaluations done concerning the expectations and experiences of visitors with the digital technology in archaeological museums. For instance, in museum Het Valkhof, the reconstructions of Roman architecture were based on scientific correctness. The videos of the reconstructions were, however, identified as too long and clinical, because more focus was put on the architecture instead of the humans within the buildings. Any assessment framework that can be used by museums to detect the experiences with digital technology of visitors is missing, as was already argued in 2007, but which is still a problem today.[133] It would be useful to detect more negative experiences, problems and limitations to further develop the usability of digital technology in archaeological museums, and to detect an expectation pattern which technical partners and museum professional both can use to increase their practices. It could, namely, be expected that certain expectations have to be met in the future concerning digital technology since this is already generally incorporated into daily life.

[131] The last numbers are from 2017: Museumvereniging, "Museum Cijfers 2017."
[132] These include the aspects of *wonder* as memories of our cities and country, *connection* as places to connect, *development* to enliven education, *experience* to produce special experiences and *enrichment* to improve the quality of the environment of visitors: Museumvereniging, "Museum Cijfers 2017."
[133] Van Vliet and Schrandt, "Kansen en Keuzestress," 26.

Chapter 2: The First Baby Steps of Immersive Technology into the Archaeological Museum

In this case study, the following questions will be answered: Why is it needed for an archaeological museum to digitally reconstruct in general, how did museums transfer information with early immersive digital technology, and lastly, for who and how was this of added value? It will be shown that the Etruscanning project was of added value in three ways: for the museum and archaeological research, for the material and for the public. The digital technology was both useful as a researchtool as well as the enhancement of the experience of the visitor. However, during the process of conducting this study, critical questions and notes appeared which were not obvious at the beginning of the study. Considering the undefined expectations within the relation between the technicians and museum professionals, for instance, or the short sustainability of the projects will reveal that sufficient marginal notes can be added to the use of the same technologies that are of added value to museum practices. It will be revealed that, although digital reconstruction technology can be of added value, problems with, for instance, the publication of 3D visualisations and missing background information evolve during the process.

2.1 The exhibition, the project and the museum

The Etruscanning-project started in May 2011 and was focused on the Regolini-Galassi Tomb, an Etruscan grave of a princess situated in Cerveteri. The tomb, dated from the orientalising periode in Etruria: the seventh and sixth century BC, was discovered by Alessandro Regolini and Vincenzo Galassi in 1836 and is important because of the amount (327) and the quality of the archaeological objects.[134] The project was part of an international cultural cooperation project between Italy, Belgium, Germany and The Netherlands and was performed by a diverse team of professions including curators, archaeologists and digital and artistic specialists.[135]

The original tomb is not open for the general public and is empty. The grave has not been methodically excavated and the objects were a year after its discovery sold to Vatican museums. The findings of the tomb are, therefore, currently scattered over different museum collections, although many of them can be found in the Gregorian Etruscan section of the

[134] Lulof and Van Kampen, *Etrusken: Vrouwen van Aanzien, Mannen met Macht*, 97, 172.

[135] The museum collaborated in this project with the Consiglio Nazionale delle Ricerche (Italy), Visual Dimension (Belgium), the Gallo-Roman Museum Tongeren (Belgium), the Vatican Museums (Vatican City), the Villa Giulia (Italy) and the National Museum of Antiquities in Leiden: “Gregorian Etruscan Museum,” Musei Vaticani, accessed June 23, 2019, http://www.museivaticani.va/content/museivaticani/en/collezioni/musei/museo-gregoriano-etrusco/sala-xvi--antiquarium-romanum--lucerne-e-stucchi/installazione-multimediale-interattiva-etruscanning.html. ; Allard Pierson, *Jaarverslag 2011.*

Vatican Museums. The objects are observed in showcases, however, it has been argued that this causes them to be "..limited to the observation and analyses of their formal aspects rather than extended to the comprehension of their intrinsic meaning."[136] Besides, Etrucan graves, cult rituals and grave gifts are since the twentienth century the most important evidence which archaeologist base their conclusions on, although diligent analysis is needed due to contradictory sources.[137] These circumstances led to the idea to create a digital tomb with laser scanning, photogrammetry and computer modelling to bring the objects together within their original space and to transform the tomb into a Virtual Reality experience.[138]

The overall aim of the project was to investigate and use new visualization techniques.[139] Two sub goals were firstly the development of new presentation techniques in collaboration with a list of partnerships that ".. went beyond many traditional borders and domains" and secondly the 3D visualisation of Etruscan graves and objects and making it accessible to a large audience.[140] The reconstruction was of educational value to the exhibition as it created a better understanding of the grave in its context.[141] Moreover, it is argued that the project promoted the production, application and spreading of 3D-reconstructions in museums.[142] The VR application was temporally installed in the Allard Pierson Museum in Amsterdam and the RMO in Leiden, as a part of the double exhibition *Etruscans: Eminent Woman, Powerful Men*[143], installed from October 2011 till March 2012.[144] It was also installed in Archeovirtual, an annual international exhibition of virtual archaeology projects and virtual museums, in 2011 and 2012.[145] In later versions of the application, more objects and refinements in the technology were added to the model. The installation was also integrated into an exhibition about Etruscan Culture in the Gallo-Roman Museum in Tongeren in 2013 and is permanently installed in the Vatican Museum since April 2013. In July 2014, it was also used for the exhibition *Les Etrusques et la Méditerranée. La cité de Cerverteri / Gli Etruschi e il Mediterraneo. la città di Cerverteri.* in Palazzo delle Esposizioni in Rome.[146]

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[136] Pietroni, Pagano and Rufa, "The Etruscanning Project," 653.
[137] Lulof and Van Kampen, *Etrusken: Vrouwen van Aanzien, Mannen met Macht*, 12, 33.
[138] Hupperetz, Pietroni, Pletinckx, Ray (ed.), and Sannibale, *Etruscanning*, 7-9.
[139] Allard Pierson, *Jaarverslag 2011*.; Pietroni, Pagano and Rufa, "The Etruscanning Project," 653.
[140] Hupperetz, Pietroni, Pletinckx, Ray (ed.), and Sannibale, *Etruscanning*, 7; Allard Pierson, *Jaarverslag 2011*.
[141] Allard Pierson, *Jaarverslag 2011*.
[142] Allard Pierson, *Jaarverslag 2011.* ; Pietroni and Rufa, "Natural Interaction in Virtual Environments for Cultural Heritage," 89.
[143] Dutch translation: Vrouwen van Aanzien - Mannen met Macht
[144] Hupperetz, Pietroni, Pletinckx, Ray (ed.), and Sannibale, Etruscanning, 9-10. Allard Pierson, *Jaarverslag 2012*.
[145] Pietroni, Pagano and Rufa, "The Etruscanning Project."; "Home," Archvirtual, accessed October 5, 2019, http://www.archeovirtual.it/index.php/en/home-2/.
[146] "Virtual Reconstruction of Regolini-Galassi Tomb," Regolinigalassi.wordpress, last modified August 4, 2014, https://regolinigalassi.wordpress.com/2014/08/.

Even though the site was discovered in 1836, it has not been documented extensively.[147] This was illustrated in partially lost information or differences in the sources about the site. To still reconstruct the original layout of the tomb just around its closing, very practical and challenging questions had to be asked about the design of the grave. Different hypotheses about the lay-out were proposed that resulted in a process in which the digital reconstruction of the model itself became a tool for experimentation and interpretation.[148]

Alongside collecting available data by excavation reports, drawings and iconographic sources about the tomb, data was also obtained through a 3D laser scanner (Riegl z39oi), photos and GIS (Fig. 3.1).[149] The point cloud from the architectural data from the laser scanner had a resolution of 6 mm space between the measurements and an accuracy of 2-3 mm.[150] It was textured and coloured by photos. Objects were professionally photographed by the use of a turntable and a white tent in order to avoid reflection and to provide clear material for making 3D digital models of the objects.[151] Some objects were hand-modelled, some were modelled by photogrammetry. In the process of modelling with the software of Blender, 3D Studio Max, Autodesk Photofly/123D Catch, Photoscan, ARC3D and Unity 3D, a close examination of the size, dimensions, damage and disturbances in the material was conducted to present them realistically and accurately.[152] Exact locations of the objects were researched to place the objects in the right room and place in the model. All the decisions that were made during the process, such as used techniques, findings and conclusions, were regularly communicated through a blog which shows that deep thought has been given to the way to digitize and visualize

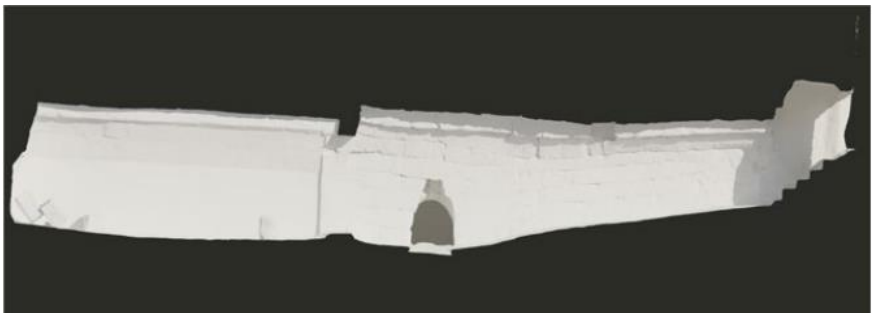

Figure 2.1: 3D scan of the Regolini-Galassi Tomb, made in June 2011.

[147] Hupperetz, Pietroni, Pletinckx, Ray (ed.), and Sannibale, *Etruscanning*, 17-18. Pietroni, Pagano and Rufa, "The Etruscanning Project," 654.
[148] Pietroni, Pagano and Rufa, "The Etruscanning Project," 654; Hupperetz, Carlani, Pletinckx and Pietroni, "Etruscanning 3D Project," 93.
[149] Hupperetz, Pietroni, Pletinckx, Ray (ed.), and Sannibale, *Etruscanning*, 19.
[150] Hupperetz, Carlani, Pletinckx and Pietroni, "Etruscanning 3D Project," 94. See for more details and photo's: "Virtual Reconstruction of Regolini-Galassi Tomb," Regolinigalassi.wordpress, last modified August 4, 2014, https://regolinigalassi.wordpress.com/2014/08/.
[151] Hupperetz, Carlani, Pletinckx and Pietroni, "Etruscanning 3D Project," 94.
[152] Hupperetz, Pietroni, Pletinckx, Ray (ed.), and Sannibale, *Etruscanning*, 29-35, 60-78.

the objects and the tomb and the assembling of the whole.[153]

Then, the application was placed in a dark and quiet room in the middle of the exhibition in Amsterdam. Through the use of physical body movement, the site could be explored by the user by walking on a map of the tomb on the ground of the exhibition space (Fig. 3.2 & 3.3).[154] In the first version of the application, the body movement, or so-called 'natural' interaction and natural interaction interface, was simple technology. Here, the visitor only had to walk in front of the projector which was equipped with automatic movement of the camera with no calibration needed, onto the interactive map on the floor.[155] The simplicity and the flexibility of the hotspots made the application easy to use for visitors of all ages and technical abilities.[156] In the second version, more complex body movement, or so-called 'gesture-based' interaction, was incorporated with skeleton recognition and the recognition of gestures. This interaction would change the boundaries between the natural and artificial, immersing visitors into the tomb, through symbolic codes like gestures and signals.[157] Visitors could freely walk through the tomb and take a closer look at specific objects by using their arms. This more complex gesture-based interaction showcased difficulties with understanding the relation between hotspots and gestures.[158]

In addition to this, the application was supported by storytelling from the perspective of the inhabitants of the tomb to create an emotional effect on the visitors.[159] The inhabitants, a princess and a warrior, speak about the objects, their identity and culture as if they were in present time. In one of the versions of the application, sound was added by using Supercollider.[160] Red dots indicated focus points and triggered the start of the played stories. To show as well as register movement in the VR simulation without suffering from line-to-sight problems, a screen of 12m2 with a low-cost and mark-less projector with a Kinect sensor was used. While the Kinetic sensor and the development of the application in Unity 3D are not new

[153] "Virtual Reconstruction of Regolini-Galassi Tomb," Regolinigalassi.wordpress, last modified August 4, 2014, https://regolinigalassi.wordpress.com/2014/08/.

[154] Hupperetz, Pietroni, Pletinckx, Ray (ed.), and Sannibale, *Etruscanning*, 79-95. Pietroni, Pagano and Rufa, "The Etruscanning Project," 653-655.

[155] Natural interaction and a natural interface is based on interacting in a 3D space through body movement, but without the use of devices. How more the visitor is familiar with the activity one has to preform, like walking or listening, the more natural and immersed the visitor can feel during the activity without feeling uneasy: Pietroni and Rufa, "Natural Interaction in Virtual Environments for Cultural Heritage," 87; Hupperetz, Carlani, Pletinckx and Pietroni, "Etruscanning 3D Project," 95.

[156] Pietroni, Pagano and Rufa, "The Etruscanning Project," 655, 658; Hupperetz, Carlani, Pletinckx and Pietroni, "Etruscanning 3D Project," 95-96.

[157] Pietroni, Pagano and Rufa, "The Etruscanning Project," 655.

[158] Pietroni, Pagano and Rufa, "The Etruscanning Project," 656, 658. Wim Hupperetz, Interview with author, 25 September, 2019.

[159] Pietroni, Pagano and Rufa, "The Etruscanning Project," 654.

[160] Ibid., 654.

Figure 2.2: The map on the floor with hotspots.

Figure 2.3: The VR application.

inventions for the gaming world, it was applied with VR to present cultural heritage for the first time.[161] No VR glasses, keyboard or console had to be used during the interaction to keep the application simple and understandable for the visitor.

In conclusion, the Etruscanning-project was of importance on different levels: as a research tool and experimental methodology for museums and researchers, for digital restoration and digitization of the tomb to increase accessibility of the material, and educational contextualization and emotional and immersive connection for the public.

The project was initiated by the Allard Pierson Museum. It received a € 200,000 grant from the European Union Cultural Programme to develop the application. Additionally, the museum received financial contribution of the Prins Bernhard Cultuurfonds, the Mondriaan Stichting, SNS reaal Fonds, the University of Amsterdam, the Vereniging van Vrienden of the Allard Pierson Museum en RoMeO, de Stichting Charema — Fonds voor Geschiedenis en Kunst and the Embassy of Italy and the Italian Cultural Institute.[162] During the exhibition, the museum attracted 67.499 visitors, of which 62% especially for the Etruscan exhibition.[163]

The Allard Pierson Museum is a middle-large Dutch museum in Amsterdam. Their mission is to show "..the significance of ancient civilizations for contemporary European culture in a current and challenging way. We do this for the largest possible audience, based on an archaeological top collection and in collaboration with talented students and excellent

[161] Pietroni and Rufa, "Natural Interaction in Virtual Environments for Cultural Heritage," 90.
[162] Allard Pierson, *Jaarverslag 2012*.
[163] Ibid.

researchers."[164] Being accessible as a museum is defined as an important value which is shown in their rebuilding program, by the creation of the so-called free accessible zone 'Allard Pierson Live'.[165] The museum is familiar with the use of digital technology, new media and interactives. In many recent exhibition, digital technology is included like leap motion in *Crossroads* (2017-2018), 3D printing in *Schijnbeweging* (2015) or basic augmented reality visualisations in *A Future for the Past* (2009).[166]

2.2 Added value

2.2.1 Added value for museum and archaeological research

It is stated in almost every publication regarding this project as well as argued in both interviews that the reconstruction of the Etruscan grave was a highly valuable research tool; it helped to analyse different lay-outs to reach a final interpretation of the tomb with all its objects within, and to present it attractively.[167] Although a museum is not a research institute, within the archaeological museums scientific correctness is of high value.[168]

There are still many questions about the Etruscan material culture, their sacral rituals and ethnical formation.[169] By analysing graves, the relation between men and woman, status and distinctive grave gifts have been discovered, although many exceptions of these distinctive grave gifts are also found. The Regolini-Galassi Tomb was an unique opportunity to analyse the formal aspects of burial rituals, the symbolism of the objects and the way in which the grave was composed.[170] All documents about the Regolini-Galassi Tomb were re-examined and re-interpreted through digital reconstruction which produced new archaeological knowledge. This resulted especially in new conclusions about the location of objects in the tomb, as the precise location of most of them was lost since they were sold to the Vatican Museums. Furthermore, interpretations about the relation between the rooms , the function of some objects and further knowledge of Etruscan funerary customs was produced. Inconsistencies were recognized between the maps of Grifi (1836/1841) and Canina (1846)

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[164] Allard Pierson, *Jaarverslag 2017.*

[165] "Visie en Missie," Allard Pierson, accessed October 5, 2019, https://allardpierson.nl/over-ons/visie-en-missie/.

[166] Meschproject, "Smart exhibition 'schijnbeweging'@ Allard Pierson Museum," streamed on September 2, 2016, YouTube video, 1:29, https://www.youtube.com/watch?v=8M5Ryn0aQAA ; NewMediaLab APM, "Leap Motion in the Allard Pierson Museum," streamed on July 18, 2013, YouTube video, 0:46, https://www.youtube.com/watch?v=tmM1MzVvMp0 ; Igeedee, "MovableSreen at Allard Pierson Museum in Amsterdam," streamed on April 8, 2009, YouTube video, 1:18, https://www.youtube.com/watch?v=0UODkvUTnAU&t=1s.

[167] Wim Hupperetz, Interview with author, 25 September, 2019; Patricia Lulof, Interview with author, 25 September, 2019; Hupperetz, Pietroni, Pletinckx, Ray (ed.), and Sannibale, *Etruscanning*, 9; Pietroni, Pagano and Rufa, "The Etruscanning Project," 654.

[168] Wim Hupperetz, Interview with author, 25 September, 2019.

[169] Lulof and Van Kampen, *Etrusken: Vrouwen van Aanzien, Mannen met Macht*, 12, 35-37.

[170] Lulof and Van Kampen, *Etrusken: Vrouwen van Aanzien, Mannen met Macht*, 97, 172.

through the visual placement of the objects in the tomb.[171] Uncertainties were discovered and could be discussed in the blog. Details, like fractures or inscriptions, that had not been recognised before through, for example, corrosion became evident by the use of new technologies like scanning.[172] The 6-headed lebes, an object that was deformed, damaged and was effected by corrosion, was restored by the use of dense stereo matching with photos and Unity3D.[173] Besides being a representative for burial rituals, the placement of the grave goods could also be viewed as a reflection of the houses in which the Etruscans lived.[174] The objects in the main grave are therefore considered private while the objects from the *anticamera* are considered public. Also practical matters were more easily discovered through the digital reconstruction: it was suggested that the *biga* (the chariot) was demounted before its placement, because it would otherwise not fit through the door.[175] Although the digital reconstruction produced a model that still had some uncertainties, it exposed new levels of analysing which could be helpful in further research.

The process of creating a reconstruction brings the opportunity to ask questions. When recreating something, one starts building from scratch.[176] Some questions might not have come to mind when relying on existing data or when focusing on the broader scheme of things. When building from scratch, details that were not noticed before become visible and therefore create a different through process. Questions that might come to mind would be: in what direction do objects point in a grave, what colour does the roof tile of a Greek temple have or how would the surroundings of an archaeological site look like when it was still inhabited?

2.2.2 Added value for material and cultural heritage

The digital restoration and digitization of materials and the tomb creates the opportunity to present the site as a whole, at different locations and in another way than behind glass.[177]

The collection of the Regolini-Galassi Tomb had never left the museum, nor Italy, according to Patricia Lulof.[178] In collaboration with Maurizio Sannibale, the curator of the Vatican Museums and the Etruscan collection, many objects could now be presented in the exhibition *Etruscans. Eminent Woman, Powerful Men.* The combination of the original objects and the digitalized material was an added value in terms of accessibility of the collection. At

[171] Hupperetz, Pietroni, Pletinckx, Ray (ed.), and Sannibale, *Etruscanning*, 21.
[172] Patricia Lulof, Interview with author, 25 September, 2019.
[173] "Virtual Reconstruction of Regolini-Galassi Tomb," Regolinigalassi.wordpress, last modified August 4, 2014, https://regolinigalassi.wordpress.com/2014/08/ : blog of 28 november 2012.
[174] Lulof and Van Kampen, *Etrusken: Vrouwen van Aanzien, Mannen met Macht*, 97-100.
[175] Lulof and Van Kampen, *Etrusken: Vrouwen van Aanzien, Mannen met Macht*, 174.
[176] Patricia Lulof, Interview with author, 25 September, 2019.
[177] Hupperetz, Pietroni, Pletinckx, Ray (ed.), and Sannibale, *Etruscanning*, 9; Pietroni, Pagano and Rufa, "The Etruscanning Project," 653.
[178] Patricia Lulof, Interview with author, 25 September, 2019.

the same time, the objects were protected against "..potential harm that can come from physically handling and moving objects to prepare for a traditional, object-based exhibition."[179] Another advantage is the ability to present the tomb in other places than its permanent location; it was presented in 3D in The Netherlands and Belgium through 3D scanning and photogrammetry, although its original location is in Italy.

When Regolini and Galassi discovered the Cerveteri tomb in 1836, they wrote about their discovery. Two excavations reports were published in 1836 and two drawings a few years later (1841 by Grifi and 1846 by Canina). Although the site was documented, it was also disturbed and emptied by the discoverers with only inconsistent and uncertain drawings to base further research on. It could, therefore, be doubted if the intentions of the discoverers were as scientific as they argued to be, or rather defined as treasure digging. Early archaeological excavation and documentation already began to develop in the end of the eigtheenth century, by for instance Caspar Reuvens (1793-1835) with his excavation on the estate of Arentsburgh.[180] The tomb, as part of cultural heritage, is now restored in a digital way. Questions could, however, still be asked whether the story behind the site, the destruction and treasure digging, was communicated and if the real tomb in Italy is differently presented.

2.2.3 Added value for public

The added value of the project for the public is also underlined in almost every publication as well as during both interviews and should therefore be considered as the most important added value of this project.[181] First, the reconstruction had educational value, because of its ability to contextualise the objects. Secondly, it expanded the experience of the visitors in three ways: into a multisensory experience in which vision as well as body movement (touch) and sound was added, into an immersive experience through the use of VR and natural interaction and into an emotional experience through the use of storytelling.

Visitors now had the opportunity to analyse the Regolini-Galassi collection in its original context, the Cerveteri tomb, something that was not possible before. The assembling of the objects in the grave changed the way visitors looked at the grave as a whole and enables them to see the items as parts of a bigger body rather than singular items.[182] Archaeological objects are not autonomous; most of the time they are not special on its own or do not speak

[179] Hupperetz, Pietroni, Pletinckx, Ray (ed.), and Sannibale, *Etruscanning*, 11.
[180] Halbertsma, "'Wel bestuurde gravingen'. C.J.C. Reuvens en de eerste wetenschappelijke opgravingen," 217-233.
[181] Patricia Lulof, Interview with author, 25 September, 2019; Wim Hupperetz, Interview with author, 25 September, 2019; Hupperetz, Pietroni, Pletinckx, Ray (ed.), and Sannibale, *Etruscanning*, 11-13; Pietroni, Pagano and Rufa, "The Etruscanning Project," 655-660.
[182] Wim Hupperetz, Interview with author, 25 September, 2019; Patricia Lulof, Interview with author, 25 September, 2019.

for itself like a painting would, and they are often fragmented. Objects need a context to communicate its full meaning. This can be presented by text, images or, in this case, by a virtual reconstruction.[183] While the exhibition provided the clearest *information* for the objects as is argued in the visitor evaluation, the installation provided indeed the clearest *contexts* about the objects (46.6% against the 25% of the exhibition).[184] This feeling was stronger when seeing the installation before the exhibition (71.4% against 14.3%).[185]

The experience of museum visitors has become a hot topic the last few decades in museum practices.[186] The project was of value for the expanding visitor experience in terms of multi sensibility, immersiveness and emotional connection.

The museum experience can be focused on different aspects, explains Hupperetz.[187] While art museum tend to focus on aesthetics, archaeological museums rather aim to influence the way visitors perceive a certain object and educate them about it. The digital reconstruction in the exhibition was used as a device to let the visitor experience the grave in a multisensory manner through the use of body movement, vision and sound. The visitor was in control over the application and other visitors could experience the application passively while sitting down in the area around it at the same time.[188]

The combination of the multisensory approach, Virtual Reality and a Kinect sensor above the visitor, allowed for the visitor to not need any devices like a joystick, keyboard or console, which created a natural interface for visitors of every age and technical abilities. This eventually produced an environment in which the visitor could be immersed into the grave in an easy and accessible manner.[189] They could follow the footsteps of the discoverers, Regolini and Galassi. The degree of immersion of the first version was tested during the Archeovirtual exhibition in 2011.[190] 58% of the participants felt a high level of immersion, 39% felt a medium level of immersion and only 3% a low level of immersion. Although these percentages do not specifically present the level of immersion in the Allard Pierson Museum, the Archeovirtual

[183] Wim Hupperetz, Interview with author, 25 September, 2019.
[184] Hupperetz, Pietroni, Pletinckx, Ray (ed.), and Sannibale, *Etruscanning*, 105.
[185] The user evaluation study used an A-B study method to measure the educational value, contextualisation of the objects and the visitor experience. Group A saw the installation before the exhibition, Group B saw the exhibition before the installation: Hupperetz, Pietroni, Pletinckx, Ray (ed.), and Sannibale, *Etruscanning*, 97- 108.
[186] For instance: Pine and Gilmore, *The Experience Economy*, 265; Hein, *Learning in the Museum*, 100-134. Falk and Dierking, *The Museum Experience Revisited*.
[187] Wim Hupperetz, Interview with author, 25 September, 2019.
[188] Pietroni, Pagano and Rufa, "The Etruscanning Project," 655.
[189] Hupperetz, Pietroni, Pletinckx, Ray (ed.), and Sannibale, *Etruscanning*, 87. Pietroni, Pagano and Rufa, "The Etruscanning Project," 658.
[190] The degree of immersion or level of immersion was tested by questions about the arrangement of the installation space, the environment and the context into which the installation was placed: Pietroni, Pagano and Rufa, "The Etruscanning Project," 658.

data can be used as an indication for the AP application, because both locations were similar; they were both placed in a dark and isolated area.

The interactive approach by the use of VR next to the exhibition was experienced positively by the visitors. 71.4% of the participants in the evaluation study indicated that the combination of installation and exhibition was what they felt a museum experience should be.[191] The conclusion that was drawn from this percentage was that the "..museum experience is shifting away from the more traditional approach of displaying objects accompanied by a short text, moving towards an experience that is more interactive and includes a wider range of multimedia formats to convey information about the collection."[192] This opinion is shared by Patricia Lulof, who works with both museological institutions and digital reconstruction.[193] In museums, she argues, audio stories are made available to restrict the text next to the objects and to tell the story behind a painting for instance. In archaeological museums, more surrounding information about an object can be told to the visitor to arouse their interest. This can be for example the environment or location and use of an object. How can this be told better than in a 3D visual language in which all layers of meaning of an object can be expressed at the same time?

The creators of the application aimed at the creation of emotional involvement with the use of dramatic light, shadows, and colour correction and through the use of storytelling.[194] Sound, or the so-called soundscape, increased the immersion into the application and therefore the emotional connection. Sounds like flutes, water and wheels of chariots were heard to foster feelings for the stories that were told by the princess and warrior.

2.3 Discussion: Problems and limitations

It seems that, especially at the beginning of the incorporation of digital technology as a device for the presentation of objects in a museum, the relation and expectations between technicians and museum professionals were not well defined. In the case of the Etruscanning, the application was dependent on technical partners and the museums did not manage the full application.[195] There was no infrastructure within the museum to manage the technical side of the application, probably due to the infancy of the incorporation of the technology in museums. But even though there is infrastructure, eventually many applications are only used for a specific exhibition with no sustainable character. Moreover, the knowledge that is needed to use, maintain and update the digital devices is not always present within the museum, leading

[191] Hupperetz, Pietroni, Pletinckx, Ray (ed.), and Sannibale, *Etruscanning*, 106.
[192] Ibid., 106.
[193] Patricia Lulof, Interview with author, 25 September, 2019.
[194] Pietroni, Pagano and Rufa, "The Etruscanning Project," 654.
[195] Wim Hupperetz, Interview with author, 25 September, 2019.

to expenses to hire professionals, although mostly little museum cannot always afford this.[196] The sustainability of an application is more integrated into projects with digital technology in the Allard Pierson Museum now to retain its added value for the objects and for the museum itself as a valuable investment. Unfortunately, this cannot yet be said of all projects and museums. However, archaeological museums become currently more aware of this sustainable aspect and slowly incorporate this into future refurbishments.[197]

Many projects are exciting, hopeful and consist of a 'Wow-factor'. However, the novelty of those projects disappear eventually over time and is replaced by new state of the art technological innovations. Although some technology is considered 'old' by especially the younger generation, the content is not.[198] The advancement of technology, and thus replacement of the old technology is in many cases of added value. For example, in the exhibition Crossroads in the Allard Pierson Museum (2017-2018), augmented reality was used to project a coloured image over the original object.[199] This way the original object and an interpreted and coloured version of the object could be presented at the same time. This process could be expanded to versions in which for instance the surrounding context of a piece of relief could be presented or the development of the object through time or its artificial colour in the case the object was 3D printed. These developments are not possible with Virtual Reality, because VR is fully organised in a virtual world. The replacement of technology is therefore not a bad thing per se, but a project with a short term usability-span should be considered a waste of effort. While the technology will probably be replaced, the content of such a project remains valuable although it will not be used anymore, so why develop it in the first place? This is, however, not yet recognized enough in general by application developers and museum professionals.

A technical scientific note was indicated during the interview with both Hupperetz and Lulof. Reconstruction can be seen as a research method as is seen in section 3.3.1. Two problems from a scientific point of view were identified when making a reconstruction: the publishing of 3D models and missing annotations with reconstruction.

It is hard to publish 3D models in ways academics usually publish articles or documents. 3D models should be viewed in 3D and not in 2D for it is the power of 3D visual imagery. When publishing online, the creation of 3D models can be executed by almost everyone and is mostly done on commercial and open-access platforms like SketchFab. Apart

[196] Arch. Museum Haarlem, Questionnaire, received October, 2019
[197] Museum Het Valkhof, Questionnaire, received October, 2019.
[198] This aspect was also pointed out by museum Het Valkhof: Museum Het Valkhof, Questionnaire, received October, 2019.
[199] NewMediaLab APM, "Leap Motion in the Allard Pierson Museum," streamed on July 18, 2013, YouTube video, 0:46, https://www.youtube.com/watch?v=tmM1MzVvMp0.

from the quality which can be questioned, if the platform closes or is replaced, for instance, the models will not be accessible anymore. When the model cannot be published and accessed, there is no scientific result that can be presented to the broader audience, which is eventually problematic.[200] Although the possibility to publish the 3D models online is one step forward, a better solution is not yet figured out.

Considering that this project was at the beginning of the development of the incorporation of immersive digital reconstruction technology, one point came to the attention through the execution of the project, which is still a problem of today: the complex framework of questions and choices the modeller has to make to finalize the reconstruction and the communication of this information. Archaeological material is usually fragmented and hypotheses about their function, location or meaning uncertain. When writing an article, uncertainties or choices can be communicated by annotations. In a digital reconstruction, this is harder to communicate. When presenting only facts, the model will not be attractive for the user and will contain holes through missing details. When presenting interpretations but without informing the visitors, the visitors will view a model that is not scientifically correct. For instance, when a reconstruction of a house is made, additional choices have to be made about the environment in which the house was situated, or traces of use, animals, inside decoration or the colour of the wood construction, although this information is not always known from the remaining material culture. Thus, the modeller has to make choices about components that are facing each other. Although these choices have to be communicated to the viewers, the question on how to do this is not yet fully explored. Present technological innovations make it able to communicate the arguments better by for instance adding layers of different interpretations, known facts and assumed details onto or in the reconstructions.[201] This was however not possible during the creation of Etruscanning, because it was a conclusion that appeared after the creation of the application.

Besides, objects can have several layers of meaning: symbolic, functional, historical.[202] These meanings can also change through transformation processes in time.[203] A 3D reconstruction with layers can show several developments and meanings above each other in which the visitor can be introduced into the contextualization of the objects along with their development in time.

The application had two versions. The first was quite simple with not many features, the second was more complex with more features. The added features made however the

[200] Wim Hupperetz, Interview with author, 25 September, 2019.
[201] Patricia Lulof, Interview with author, 25 September, 2019.
[202] Wim Hupperetz, Interview with author, 25 September, 2019..
[203] This is what Patricia Lulof describes as 4D: three dimensional with the fourth dimension of time.

application harder to understand.[204] Hupperetz indicated that this was one of the pitfalls for technicians in which the usability is valued beneath the possibilities of the technology. However, the simplicity and quality of the application were experienced as disappointing for Lulof, although it was one of the first projects experimenting with this digital reconstruction technology in a museum.[205] It was also concluded that the aesthetic impact of the first version of the installation was of lower quality than the later version due to the running development of the application.[206] Moreover, according to the user evaluations of the Archeovirtual exhibition, a high percentage of the participants found the application simple (67%) and undemanding (50%), thus easy to use and interact with.[207] The contrasting expectations of the different parties within the project reflect, again, that the relationship and leading expectations between the technicians, museum professionals and visitors are far from clearly defined. It is recognized by Hupperetz that the triangle between conservators, metadata and technicians is not well connected yet.[208] A better connection between these three along with better studies to specifically visitor expectations and experiences with digital technology should be the basis of further projects. Together, important questions, like which values should be leading in the future or what do we expect of digital technology as a device, could be discussed and answered wherein parties are working together instead of working past each other. This can eventually lead to inventive and sustainable solutions.

There is a certain tension between the creation of 3D reconstructions and showing them in archaeological museums.[209] Archaeological objects do not always speak for themselves, so interactive screens are added to communicate their content or meaning. But do museums want visitors to look at the screens instead of the original objects? A balance should be sought to let visitors enjoy both sides as well as letting the device be of added value for the object without overwhelming it. Although it was argued by participants that the application was complementary to and of added value for the exhibition, the installation alone was not enough. The exhibition provided the "..tangibility or authenticity.." and it was argued that the "..digital is something other than real life, but digital never wins at being 'real'."[210] Virtual environments with digital objects should therefore not replace authentic objects, but rather supplement the traditional object-based museum practices. "It is the combination, the

[204] Pietroni, Pagano and Rufa, "The Etruscanning Project," 655.
[205] Patricia Lulof, Interview with author, 25 September, 2019.
[206] Pietroni, Pagano and Rufa, "The Etruscanning Project," 658.
[207] Ibid., 658.
[208] Wim Hupperetz, Interview with author, 25 September, 2019.
[209] Ibid.
[210] Hupperetz, Pietroni, Pletinckx, Ray (ed.), and Sannibale, *Etruscanning*, 107.

balance, the dynamics between the two [original objects and digital devices] that is important," as is stated at the end of the interview by Lulof.[211]

[211] Patricia Lulof, Interview with author, 25 September, 2019.

Chapter 3: The Process Counts

In this case study, the following questions will be answered: Why is it needed for an archaeological museum to reconstruct cultural heritage that is destroyed, how and with which reasons do museums recently transfer information with digital technology, and lastly, how is this changed through time concerning the added value? The exhibition, and the digital technology, was essentially adopted for the communication of the story. Although, the exhibition produced new archaeological knowledge about the colours on the reliefs in the Assyrian palaces, thus creating a better understanding of the original objects, critical questions could also be posed against this as the research on the colours was mainly intended for the presentation of the story rather than the archaeological research. The exhibition was certainly of added value for the material and cultural heritage and for the public as it increased the awareness about heritage at risk and the possible solutions to save, protect or rebuild material. However, during the process of conducting this study, critical questions and notes appeared, similar to the Etruscanning, which were not obvious at the beginning of the study. It will be uncovered that many marginal notes, that were already visible after the Etruscanning project in 2011 / 2012, could still be applied to recent projects. It will be examined that the line between a being a device and being a subject is more difficult to demount. Besides, it will be analyzed that museums fail to present information about the process behind reconstructions, while this might be valuable to demonstrate. It is, however, hopeful to see that the museum did learn for earlier projects as they produced a sustainable purpose of one of the reproductions.

3.1 The exhibition, the digital elements and the museum

In 2017-2018, the Dutch National Museum of Antiquities (NMA) in Leiden held a temporal blockbuster exhibition *Nineveh - The Great City*[212] about the Assyrian city of Nineveh. The remains of the ancient city (urban city since the fourth millennium BC till 612BC, although older remains are found) are situated in modern Iraqi, currently partly covered by the city of Mosul.[213] A long history had prevailed the city before its destruction in 612BC. But also after its destruction in 612BC, it has remained the upmost attention as was observed with the most recent photographic research, when ISIS dominated the area since 2014.[214] Along with the

[212] Dutch version: Ninevé, Hoofdstad van een Wereldrijk. The exhibition was made in cooperation with Blockbusterfonds, Mondriaan Fonds, National Geographic, Nationale Unesco Commissie, Prins Bernhard Cultuurfonds, Prins Claus Fonds, Fonds 1818, Turing Foundation, BankGiro Loterij, Stichting Zakenvrienden RMO.
[213] Petit and Bonacossi, *Nineveh, Hoofdstad van een Wereldrijk*," 6, 107.
[214] "Nineveh, Ancient Assyria (Modern Iraq)," Learning Sites, updated August 11, 2017, http://www.learningsites.com/Nineveh/Nineveh_home.php ; Petit and Bonacossi, *Nineveh, The Great City*, 265-269.

capture of the city Mosul in February 2015, ISIS destroyed and looted many archaeological sites and museums and diminished the amount of original objects, from the site and within the museum, of the archaeological site of Nineveh even more. This happened simultaneously with the research for the exhibition.[215]

Nineveh was located in an fertile area wherein it was possible to live both as hunter and gatherers and cultivate the lands.[216] Due to the presence of two rivers, the Tigris and the Khosr, the city was connected to the rest of Anatolia and served as a centre of a broad and far-reaching network since the fourth millennium BC. The first settlements evolved into a city with temples, water systems, intellectual life and royal palaces on the acropolis of Kuyunjik.[217] Nineveh became an important religious centre of the goddess Ištar during the eighteenth century BC. The fall of Nineveh, generally agreed in 612 BC, marked the ending of the city as well as the Assyrian culture. The site has been excavated and researched since the 19th century by several countries, and its antiquities were transported to or bought by museums in France, Italy, the United Kingdom, Germany, Belgium, the Netherlands, the United States and Turkey. Many objects are nowadays scattered in countries all around the world.[218] The NMA had to co-operate with a lot of international museums to assemble objects for the exhibition.[219] The site can still be considered important cultural heritage for local, national and global history as it could be distinguished as a representative site for Assyrian culture as well as an example for nineteenth and twentieth-century archaeological practices.

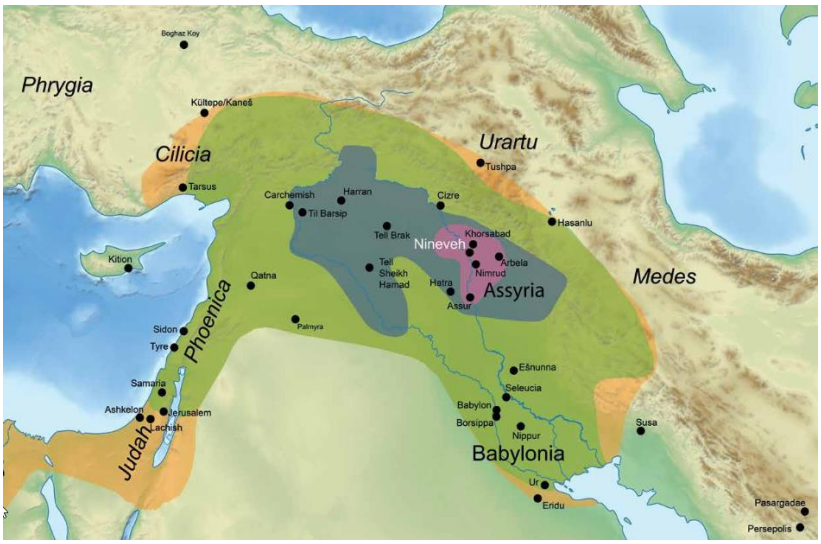

Figure 3.1: The Assyrian Empire in modern day Iraq with in the middle the location of Nineveh.

[215] Petit and Bonacossi, *Nineveh, Hoofdstad van een Wereldrijk*," 6, 132. On Youtube, several videos can be accessed wherein IS destroys parts of Nineveh, Palmyra and Nimrud.
[216] Petit and Bonacossi, *Nineveh,The Great City*, 107-123.
[217] Ibid., 125-249.
[218] Ibid., 285-286.
[219] "Nineveh - Heart of an Ancient Empire," The International Association for Assyriology, updated Februari 1, 2018, https://iaassyriology.com/nineveh/ ; Petit and Bonacossi, *Nineveh, Hoofdstad van een Wereldrijk*," 6.

In the exhibition, NMA showed several reconstructed parts of the archaeological site to create a better cultural context of the site and the objects. They were made in cooperation with several technical partners and presented by the use of multiple technologies and devices. These included two reconstructed computer animations of the Assyrian city on screens through the exhibition space, two 3D printed reproductions of a bas-relief, the reconstruction of Room V of the Southwest Palace including colour reconstruction and replicated winged lion sculptures called Lamassu.[220] The percentage of reproductions compared to originals was ten against approximately 250 original objects from domestic and foreign museums, although many reproductions were significant in size and therefore more visibly present in the exhibition room in comparison to smaller original objects.[221] It is argued by the director of the NMA, Wim Weijland, that these replicas were necessary to tell the story as good as possible.[222]

The exhibition gave special attention to the value of world heritage, the preservation of the past for the future and the recent destruction of heritage in crisis situations like the terrorist attacks in Iraqi. It promoted, for example, the movement #unite4heritage on Instagram to support world heritage and make the public more aware of its importance. This movement was specifically started to fight "..the deliberate destruction of cultural heritage by violent extremist groups.." and is trying to arouse the interest of young audiences.[223] The exhibition received patronage from UNESCO for the international importance of this exhibition.[224] The technologies and digital devices were examples to introduce and explain how technology is already used as a device for helping humanity by preserving its past for future generations.[225]

Public activities before and during the exhibition highlighted this focus on the destruction of heritage. In *Scanning For Syria* NMA, TU Delft and the University of Leiden developed a method to preserve archaeological knowledge for future generations and reconstruct lost archaeological material. The reconstructed objects of this project, off which some originals are now destroyed, like the Assyrian clay tablets from the archaeological museum in Raqqa, bears great scientific value.[226] Besides, on November 25 and 3 and 11 March 2018, NMA made it possible, in cooperation with the Dutch foundation VALUE, to

[220] "Nineveh 20 oktober 2017 t/m 25 maart 2018," RMO, accessed October 10, 2019, https://www.rmo.nl/tentoonstellingen/tentoonstellingen-archief/nineveh/.
[221] Lucas Petit, Interview, received 1st of October, 2019.
[222] " 'Nineveh' Tentoonstelling van het Jaar 2017!," Museumtijdschrift, updated 2019, https://museumtijdschrift.nl/nineveh-tentoonstelling-jaar-2017/.
[223] "Home," Unite4heritage, accessed October 5, 2019, https://www.unite4heritage.org/.
[224] "Tentoonstelling 'Nineveh'," Unesco Nederlandse Commissie, updated June 1, 2018, https://www.unesco.nl/nl/publicatie/jaarverslag-2017-kennis-voor-iedereen/erfgoed-in-crisissituaties/tentoonstelling-nineveh.
[225] "Nineveh 20 oktober 2017 t/m 25 maart 2018," RMO, accessed October 10, 2019, https://www.rmo.nl/tentoonstellingen/tentoonstellingen-archief/nineveh/.
[226] RMO, *Jaarverslag 2017* ; RMO, *Jaarverslag 2018*, 32.

visualise Nineveh with the use of the game Minecraft in combination with VR glasses.[227] The Minecraft project was well visited. The purpose of this project was to arouse a dialogue between heritage professionals, archaeologists and visitors by rebuilding parts of Nineveh in Minecraft and create a conversation about heritage at risk.[228] Additionally, the museum held a scientific congress *Creating and Recreating Nineveh* on the 22nd of January.

Computer animations

One digital reconstructed computer animation of several parts of the Assyrian city such as the Upper Town, Southwest Palace, North Palace and Nergal Gate was made by the company Learning Sites, that at that time was working on a reconstruction of Nineveh (fig. 3.2).[229] The reconstruction mostly incorporates structures of buildings and architectural details from Nineveh in the time of King Sennacherib (704-681 BCE) and King Ashurbanipal (668-627 BCE), both important figures in terms of improving and remodeling the city at the time of their reign.[230] The reconstruction of Learning Sites was made with known data of excavations, photographic data and the expertise of Assyrian specialists.[231] It is assumed that the reconstructed computer animation presents the city just before it was destroyed.

Figure 3.2: The scientific reconstruction of Nineveh by Learning Sites.

Figure 3.3: The computer animation of the dressed interpretation in the exhibition room.

[227] "Nineveh: Minecraft," Value Foundation, updated 2017, http://value-foundation.org/nineveh-minecraft/ ; Angus Mol, Interview, executed 27 September, 2019.
[228] RMO, *Jaarverslag 2017*, 84.
[229]"Nineveh, Ancient Assyria (Modern Iraq)," Learning Sites, updated August 11, 2017, http://www.learningsites.com/Nineveh/Nineveh_home.php.
[230] "Nineveh, Ancient Assyria (Modern Iraq)," Learning Sites, updated August 11, 2017, http://www.learningsites.com/Nineveh/Nineveh_home.php ; Lucas Petit, Interview, received 1st of October, 2019.
[231] "Nineveh, Ancient Assyria (Modern Iraq)," Learning Sites, updated August 11, 2017, http://www.learningsites.com/Nineveh/Nineveh_home.php.

Accuracy and sensitivity are valued highly by Learning Sites in the development of a 3D reconstruction.[232] A 3D (VR) model is made in four steps.[233] First, all 2D data is assembled such as excavation drawings or photos. After this, the data is scanned and joined into a modelling program such as CAD or 3DStudioMax that converts the data into a 3D vector-based and scalable computer model. In this process, height can be added to the model. This step creates polygonal shapes such as walls, floors or ceilings. The model is fully checked on gaps and mistakes during the conversion until it is as accurate as possible. The next step consists of texture mapping; the adding of texture, realistic colours, shadows, reliefs and monumental sculptures to the model with the use of drawings and photos. Within the modelling program, walkingpaths are rendered from different angles and inserted into the application. The last step is the conversion of the model to VRML (Virtual Reality Modelling Language) wherein the user is free to move. In the last few steps, interpreted details can be added to increase the persuasiveness of the model, although caution here is important to make sure the model remains accurate.

Figure 3.4: The computer animation of the dressed interpretation in the exhibition room.

Kais Ishak, a 3D visual designer and engineer who is concerned with the creation of digital reconstructions of Iraqi heritage for educational, non-commercial and political purposes, made the second reconstructed computer animation (fig. 3.3 and 3.4).[234] The reconstruction is a video of the city as a more dressed interpretation, which the maker describes as “Iraqi touch” because of his Iraqi background.[235] It is not known which evidence his assumptions are based on and it therefore also unknown which period in time is reconstructed in this model.

[232] “Introduction: What We Do,” Learning Sites, updated November 17, 2016, http://www.learningsites.com/Support_pages/whatwedo_2016.php.
[233] There is no publication about the making of the Nineveh reconstruction, although the company online published an article ‘How we Build a Rendered 3D Model’ about the Northwest Palace of Nimrud in which their pipeline becomes visible: “How We Build A Rendered 3D Model,” Learning Sites, updated March 13, 2007, http://www.learningsites.com/NWPalace/HowWeBuildaModel02/RenderProcess.htm.
[234] “Iraqi Artist preserves Iraqi Heritage in 3D Exhibition,” Al Shahid News, updated December 26, 2018, https://alshahidwitness.com/iraqi-artist-heritage-exhibition/.
[235] All his reconstructions are accessible on his vimeo site: “Kais Jacob Ishak,” Vimeo, updated 2019, https://vimeo.com/user9681903.

3D printed bas-reliefs

One case in the exhibition showed two 3D printed bas-reliefs of the similar bas-relief of an Assyrian soldier (fig. 3.5).[236] The section was found in Room V (no. 34) of the South-West Palace during the creation of a 3D reproduction of the entire room. This piece was specifically chosen because it shows how bas-reliefs can be reconstructed with digital restoration technology that is based on light, shadows and depth in images.[237] Bas-reliefs are flat surfaces with thin flat sculptures on it, which are visible through minimal depth change.[238] Image-based technology was needed because physical access to the site was not possible anymore and some parts were destroyed due to the ongoing war in the area.[239]

Figure 3.5: 3D printed bas-reliefs.

In 2002, an Italian team of archaeologists did make photographs of the bas-reliefs although these were not produced for the purpose of building a 3D reconstruction. In cooperation with QdepQ, an algorithm was invented that "..separates the local changes in the illumination corresponding to the texture variations in the image to preserve the smaller details of the bas-relief, as well as the global illumination over the image to reveal the shape of the entire object."[240]

This eventually resulted in two 3D printed models for in the exhibition: one model as an exact copy of the original, the second as an interpretation of the original without the damages. The 3D prints were made in co-operation with the Technical University of Delft and the Tokyo University of the Arts.[241] The copies showed how realistic technology based on images can copy and supplement archaeological objects.

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[236] Musea.tv, "Nineveh in Rijksmuseum van Oudheden - Kwetsbaar Erfgoed en Technologische Ontwikkelingen," streamed on November 15, 2017, YouTube video, 6:26, https://www.youtube.com/watch?v=gZBYP3H3RrY&t=101s.

[237] Petit and Bonacossi, *Nineveh,The Great City*, 280.

[238] Ibid., 278.

[239] Petit and Bonacossi, *Nineveh,The Great City*, 279 ; Lucas Petit, Interview, received 1st of October, 2019.

[240] Petit and Bonacossi, *Nineveh,The Great City*, 280 ; "Home," QdepQ, accessed October 6, 2019, https://www.qdepq.com/.

[241] "3ME Werkt Mee aan Tentoonstelling met 3D-Reconstructie van een Verloren Gegane Assyrische Paleiszaal," TU Delft, updated July 12, 2017, https://www.tudelft.nl/2017/3me/3me-werkt-mee-aan-tentoonstelling-met-3d-reconstructie-van-een-verloren-gegane-assyrische-paleiszaal/.

Coloured reconstruction of Room V of the Southwest Palace

The same partnership that worked on the 3D printed bas-reliefs also created a digitally coloured reconstruction of parts of a room in the Southwest Palace (Room V) to show the audience "..a realistic impression of a remote site..".[242] In the exhibition, the public could walk through a hallway with 3D reproductions of the reliefs on the walls (fig. 3.6 and 3.7). A video of a projection that covered the reliefs and added colour to them would start when someone entered the hallway.[243] Although the museum wanted to reconstruct the full room, only parts of the room could be reconstructed due to costs and limited time.[244] It is not known why particularly these reliefs were chosen.

Figure 3.6: Reconstructed palace room with colour reconstruction.

During the excavations, when the site area was still accessible, topological data and excavation details about the room were produced along with photographic material. This material was analysed later to generate a 3D reconstruction of the room, because physical access, like with the bas-reliefs, was not possible. With the use of XRF equipment, three Assyrian reliefs of the NME were analysed for pigments on its surface, which resulted in new knowledge of details of the original colouring of Assyrian wall fragments.[245]

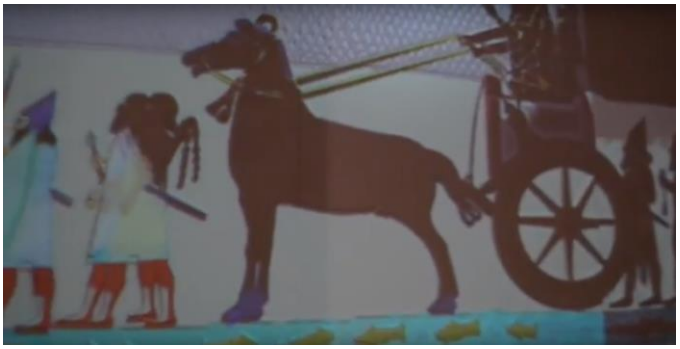

Figure 3.7: Reconstructed palace room with colour reconstruction.

Replicated lamassus

At the end of the display, two replicas of winged lion sculptures, called Lamassu, were displayed (fig. 3.8). The lamassus were found at the North-West Palace of Ashurnasirpal II and were discovered around 1940 and transported to the British Museum by a British

[242] Petit and Bonacossi, *Nineveh,The Great City*, 278-280.
[243]Musea.tv, "Nineveh in Rijksmuseum van Oudheden - Kwetsbaar Erfgoed en Technologische Ontwikkelingen," streamed on November 15, 2017, YouTube video, 6:26, https://www.youtube.com/watch?v=gZBYP3H3RrY&t=101s.
[244] " 'Nineveh' Tentoonstelling van het Jaar 2017!," Museumtijdschrift, updated 2019, https://museumtijdschrift.nl/nineveh-tentoonstelling-jaar-2017/.
[245] X-ray fluorescence equipment can be used to examine chemical compositions of material: Shackley, *X-Ray Fluorescence Spectrometry (XRF) in Geoarchaeology*; Petit and Bonacossi, *Nineveh,The Great City*, 160-166.

archaeological team.[246] The winged lions flanked important entrances in city walls or palaces to impress visitors and create a sense of protection.[247] Perhaps, it could be argued they were included in the exhibition for their purpose as impressive guardian gods to guard over the exhibition. The museum wanted to include the lamassus to reconstruct an Assyrian palace room, probably around the coloured reconstruction of Room V of the Southwest Palace.[248] Due to the size and weight of the sculptures, loaning the objects from the British Museum or the Louvre was not possible. Factum Arte already made a convincing replica in the past, in cooperation with the Britsh Museum. For this reason, in 2016 and 2017, Factum Arte was ordered to make another facsimile of the statues for the exhibition.[249] The sculptures were donated to the Archaeological Museum in Mosul after the exhibition.

Figure 3.8: Printed Lamassus.

The exhibition resulted in high visitor numbers. During the exhibition of Nineveh (between 19 October and 31 December 2017), the museum was visited by 57.071 visitors.[250] This number of visitors, along with the exhibition fee resulted in an increase of profit of approximately 1 million in total in entrance fees and store sales. The total number of visitors was 142.495.[251] The exhibition was given to title Exhibition of the Year 2017 by the Museumtijdschrift.[252]

The Dutch National Museum of Antiquities (in Dutch: Rijksmuseum van Oudheden) is a middle-large archaeological museum in Leiden. They are "..convinced that reliable transfer of knowledge and exchange about ancient cultures enrich the present and be an anchor in

[246] "Lamassu from the North-West Palace of Ashurnasirpal II," Factum Foundation, updated 2019, http://www.factumfoundation.org/pag/1079/Winged-Lions-from-the-North-West-Palace-of-Ashurnasirpal-II. ; "Nergal Gate," Learning Sites, updated December 12, 2016, http://www.learningsites.com/Nineveh/NergalGate_Nineveh_home.php.
[247] RMO, *Jaarverslag 2017,* 78.
[248] Ibid., 78.
[249] RMO, *Jaarverslag 2017,* 78; "Lamassu from the North-West Palace of Ashurnasirpal II," Factum Foundation, updated 2019, http://www.factumfoundation.org/pag/1079/Winged-Lions-from-the-North-West-Palace-of-Ashurnasirpal-II.
[250] RMO, *Jaarverslag 2017*.
[251] RMO, *Jaarverslag 2018*.
[252] " 'Nineveh' Tentoonstelling van het Jaar 2017!," Museumtijdschrift, updated 2019, https://museumtijdschrift.nl/nineveh-tentoonstelling-jaar-2017/.

the present society", as is stated in their vision.[253] Their mission is to enliven antiquity and archaeology for a diverse audience, for which the qualities of connection, authenticity, initiative-driven, reliability and public-friendly are core values. The target audience van be subgrouped into entertainment seekers, students, newcomers and captivated professionals and nonprofessionals. The museum is familiar with the use of digital technology, new media and interactive tools. In their kids-exhibition, *Back to the Ice Age* (Terug naar de IJstijd) in 2014 for example, an interactive and sensory design was used to transport the visitor back in time to experience the coldness and misinterpretations of the Ice Age.[254]

3.2 Added value

3.2.1 Added value for the museum and archaeological research

One of the most important aspects that was taken into account in the process of creating digital reconstructions was the scientific correctness of the reconstructions.[255] The reconstructions had to be as close to the original as possible. The museum cooporated with professional companies like Learning Sites and Factum Arte, that are both working with cultural heritage and digital immersive technology. Only one of the reconstructions was meant to be visually attractive instead of scientifically reliable. [256]

Research concerning the colouring of reliefs in Assyrian palaces, and adding the correct colours to the reliefs in the exhibition digitally, was part of a scientific study. Little research has been conducted until now in the use of colours onto these reliefs, according to Petit.[257] The research, that was conducted with scientific and specialised partners and technical devices like an XRF, resulted in new conclusions about the reliefs and added a new layer to the reconstructions. Thus, the research was of added value for the understanding of the original objects. However, this can be considered irrelevant as the reconstructions were largely produced to communicate the story better to the visitor rather than understanding the colours of the reliefs.

3.2.2 Added value for material and cultural heritage

[253] Translated from Dutch: Het RMO heeft de overtuiging dat betrouwbare overdracht van kennis en uitwisseling over oude culturen het leven van nu verrijken en een anker vormen in de huidige samenleving: RMO, *Jaarverslag 2018.*

[254] "Terug naar de IJstijd," Synergique, updated 2019, https://synergique.nl/portfolio/tentoonstelling-ijstijd/.

[255] Lucas Petit, Interview, received 1st of October, 2019.

[256] The reconstruction of Kais Ishak was an interpreted reconstruction of the city.

[257] Lucas Petit, Interview, received 1st of October, 2019.

The exhibition was divided into three storylines whereof one storyline was specifically addressing currently endangered heritage.[258] Reconstruction of cultural heritage with digital technologies and devices was the subject of the last room, called the 'heritage room'.[259] In this room, the destruction of cultural heritage and the solutions to capture, preserve and rebuild archaeological material was the main theme. The exhibition, therefore, had added value for cultural heritage in general and objects specifically as it increased awareness about the subject along with an awareness for possible solutions to save, protect or otherwise rebuild the material.[260]

For instance, the 3D printed bas-reliefs in the coloured reconstruction of Room V of the Southwest Palace are destroyed by ISIS. Apart from the goal to use the reconstruction for the communication of the story, the reliefs were also reconstructed to digitally preserve the material.[261] Likewise, the lamassus were ment to draw attention to heritage at risk since they were destroyed by ISIS but also to entertain the visitor.[262] Petit argues that the reconstruction of the lamassus demonstrated that heritage is not only a materialised object but also a social memory of ancient times. For this reason, the lamassus will be given to Iraq to retain, at least, the 3D printed representations of their ancient cultural heritage.

3.2.3 Added value for public

It can be argued that the digital reconstructions added most value for the public who visited the exhibition. This can be argued from two perspectives: the educational aspect, also containing communication of the story, and the experience of the visitor.

Clear communication about the story was the most important goal of the use of the reconstructions, as is argued by both the director of the NMA, Wim Weijland, and Lucas Petit.[263] Reconstructions are meant to make objects or a situation visual, as museums are not only institutions that exhibit objects but also present past stories.[264] While original objects

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[258] " 'Nineveh' Tentoonstelling van het Jaar 2017!," Museumtijdschrift, updated 2019, https://museumtijdschrift.nl/nineveh-tentoonstelling-jaar-2017/ ; Angus Mol, Interview, executed 27 September, 2019.

[259] Angus Mol, Interview, executed 27 September, 2019.

[260] This awareness is identified in a visitors review: "Tentoonstelling Nineveh: 'Een Heel Evenwichtig Overzicht van de Geschiedenis van de Stad'," Devi Smits (Volkskrant Online), updated Januari 27, 2018, https://www.volkskrant.nl/cultuur-media/tentoonstelling-nineveh-een-heel-evenwichtig-overzicht-van-de-geschiedenis-van-de-stad~bdb3d4a8/.

[261] Lucas Petit, Interview, received 1st of October, 2019.

[262] A video of the destruction of the lamassus, broadcasted in 2015: CBS This Morning, "ISIS destroys ancient artifacts in Mosul," streamed on Februari 27, 2015, YouTube video, 2:53, https://www.youtube.com/watch?v=i1pGJPMp9fY&t=3s ; Lucas Petit, Interview, received 1st of October, 2019.

[263] Lucas Petit, Interview, received 1st of October, 2019; " 'Nineveh' Tentoonstelling van het Jaar 2017!," Museumtijdschrift, updated 2019, https://museumtijdschrift.nl/nineveh-tentoonstelling-jaar-2017/.

[264] Lucas Petit, Interview, received 1st of October, 2019.

are impressive on their own, it can be quite difficult to understand them properly without a context or when the information is only explained in a text. Reconstructions that show context, use or shape can be more meaningful as they make the objects more understandable. It can bring objects to life, especially when they could otherwise not be exhibited, partly or as whole. Digital reconstructions form an additional, usually multi sensible, information source for visitors and an educational tool for the museum. For example, the 3D reconstructed reliefs in the hallway would be perceived differently, less special even, when they were not coloured, since the exhibition already incorporated a lot of original reliefs. The adding of colours was considered valuable as it showed the original beauty of the reliefs.[265] They were described as kitschy but surprising by visitors.[266]

The reconstructions were also meant for entertainment purposes and to broaden the experience of the visitor.[267] By communicating information through additional visuals; the animations, and physical objects that could otherwise not be exhibited; the bas-reliefs and lamassus, the visitor is dazzled in a way an ordinary exhibition could not. An important goal of the exhibition was to show the visitor how significant and impressive the city was around 700 BCE.[268] It can be argued that almost all digital reconstructions did contribute to this goal. The largeness of the lamassus would not be experienced if they had not been reconstructed. The fly-over communicated the size of the city in a way an ordinary drawing or number would never be able to. The museum used 3D printed objects and displayed them similar with other original objects (see fig. 3.4, statue on the front). Unfortunately, it is not known if the visitor could touch these 3D printed objects or if it was communicated they could, since this could have been a large benefit of this technology, making their experience into a multi sensory one. Contrarily, remaking a stone statue with a 3D printer does give excellent visual results, recreating the object with the same material properties like weight and texture, especially since stone cannot be printed, does not yet resemble the real objects.[269] Furthermore, during the exhibition, the NMA organised a VR day where visitors could digitally walk through a palace in Iraq by wearing VR-glasses. This was experienced as a special experience by visitors, although it is assumed that not many visitors could enjoy the experience as it was a one-day-only event, due to costs.[270]

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[265] Angus Mol, Interview, executed 27 September, 2019.
[266] "Tentoonstelling Leiden - Nineveh Hoofdstad van een Wereldrijk,"Historiën, updated November 8, 2017, http://www.historien.nl/tentoonstelling-leiden-nineveh-hoofdstad-van-een-wereldrijk/ ; "Nineveh-tentoonstelling in Rijksmuseum van Oudheden," Historiek, updated November 6, 2017, https://historiek.net/nineveh-tentoonstelling-rijksmuseum-van-oudheden/71967/.
[267] Lucas Petit, Interview, received 1st of October, 2019.
[268] Ibid.
[269] In 2018, research has be conducted into the 3D printed physical reproduction of limestone slabs, with the focus on metrical precision and accuracy, for didactic purposes: Ballarin, Balletti and Vernier, "Replicas in Cultural Heritage."
[270] Lucas Petit, Interview, received 1st of October, 2019.

The exhibition was titled Exhibition of the Year 2017 by readers of the journal *Museumtijdschrift*, museum fans and a professional jury. Visitors appreciated the exhibition for being".. educational, beautiful, informative..", the animation "..impressive..", the replicas "..inspiring.." and the overall exhibition convincingly concerning destruction.[271]

3.3 Discussion: Problems and limitations

Although all technical advancements received much applause, it has also been expressed that the amount of 'high-tech' was too much.[272] The line between being a device and being a subject is maybe thinner that most people think. The digital devices in the exhibition could be generally considered as distracting; forming an unnecessary link between high-tech technology and cultural heritage in danger; being uninforming about the creation; and having a imperial undertone. Besides, it might raise questions about the credibility of certain topics, that might be presented as factural even though there is no academic consensus.

Digital technology can be a distraction for both the visitor and the museum staff that is organising an exhibition.[273] The technology, to impress and surprise visitors and to create new ways in which visitors can perceive ordinary material differently, is usually new and unfamiliar.[274] Visitors were surprised and drawn to the technology in the Nineveh exhibition. This way, technology becomes indirectly part of the subject apart from the product itself. Unfortunately, since there was no user evaluation, it is not known if and what kind of questions were raised by visitors by the use of these technologies. Moreover, museum professionals could also be distracted by all of the possibilities of technology.

Additionally, destroyed or endangered heritage in the last room, the 'heritage room', was very directly connected to digital solutions and 'high tech' innovations, although this focus is not the only solution for the problem that was highlighted.[275]

The more complex technology becomes, the harder it is to comprehend the production methods. It is the information that is not visible that could also benefit the understanding of the protection and the handling of cultural heritage and the interest of the visitor. Did the makers of the reconstruction, for instance, had to trace back information from other material to reconstruct the palace room due to the destruction of the original material? Who is making it and how does the technology work? Did the visitors understand that some objects were reconstructions instead of original objects? How long did it take to make the 3D printed bas-reliefs? What is the eventual value of a non-original 3D printed or reconstructed

[271] " 'Nineveh' Tentoonstelling van het Jaar 2017!," Museumtijdschrift, updated 2019, https://museumtijdschrift.nl/nineveh-tentoonstelling-jaar-2017/.
[272] Angus Mol, Interview, executed 27 September, 2019.
[273] Ibid.
[274] Discussed in chapter 2.3.3.
[275] Angus Mol, Interview, executed 27 September, 2019.

object? The visitor only observes the end product of the digital technology but is not part of the process behind it, while this might be valuable to understand. Comparable to the Etruscanning project, it is viewed that the complex framework of questions and choices the modeller has to make to finalize the reconstruction is still difficult to communicate in a museum. Certainly, the NMA did present information on how reconstructions can be made: in the heritage room, it was explained how images could produce 3D reconstructed models.[276] However, it is not clear whether the visitor did indeed understand the technology and its complexity that is needed to create the reconstructions. It is not recommended to show the entire reconstruction process as the reconstructions should act as a device and not act as a subject. However, it could be argued that a better understanding of the process is needed to fully understand how audiences are influenced in their perception of authenticity and interpretations as well as museum practices. Besides, some technologies are not yet capable of presenting the annotations they include. The computer animations were, for instance, converted from the digitally reconstructed 3D visualisations into a fixed one-layered digital video or digital image to fit into the exhibition. The visitor could not change the way the material was presented. However, this could be possible, for instance, when visitors have control over the application, something that was possible in the Etruscanning application, or when more layers are added with annotation clouds that incorporate the background story. When a museum withhold itself from giving away control over the perception of material, questions could be asked whether it is an act of convulsive retaining its authoritive voice as a museum.

Historically speaking, museums have, roughly speaking since the 19th century, often appropriated objects that originally did not belong to them or their country. Reflections of these processes are still present in western society, and it has been recognized that digital reconstruction can play a role in this process when ethicality is not sufficiently considered. This research will not argue whether the NMA was involved in decolonial practices. The exhibition will, however, be discussed in the light of the current difficulties within this subject.

Since the destruction of the Buddhas of Bamiyan in 2001, the debate started whether cultural heritage should be resurrected in the first place - and if so, how.[277] Replication was considered inappropriate for, among other things, ethical and moral reasons. Another example is the Arch of Triumph (Tadmor), an arch that was originally situated in Palmyra Syria and destroyed by ISIS in 2015. It was reconstructed by the English Institute of Digital

[276] Musea.tv, “Nineveh in Rijksmuseum van Oudheden - Kwetsbaar Erfgoed en Technologische Ontwikkelingen,” streamed on November 15, 2017, YouTube video, 6:26, https://www.youtube.com/watch?v=gZBYP3H3RrY&t=101s.
[277] Burch, “A Virtual Oasis,” 69; Janowski, “Bringing Back Bamiyan’s Buddhas.”

Archaeology (IDA) and shown in London, New York, Dubai and Florance.[278] The Arch was defined as shared cultural heritage and a political symbol against terrorism. Unfortunately, not everyone agreed with the building process, where it was situated, and what it represented. The reconstruction of the Arch was accused of beint a colonialist action.[279] The accusation originated from the fact that the arch was hopping between only western countries since the opening in London, although it was claimed to be shared world heritage. An evaluation of the arch by the visitors who saw the reconstruction revealed that 40% of the people had mixed or negative feelings considering the Arch.[280] It raised critical questions like: "Is it for self-gratification or remembrance?" along with revealing sentiment about the political and colonial undertone of the monument, according to the author.[281] The need for a reproduction was called "Westernised" because of the "importance of stuff".[282] The previously mentioned examples are however objects that are situated outside museums.

Ethical principles are not adapted to the new digital way of reconstructing; no official rules or codes have yet been made about the digital process of reconstructing, was argued in 2018.[283] It is hopeful to see that the NMA did think about a further, sustainable, purpose of the lamassus by giving them to the museum in Mosul. The return of digitally reconstructed cultural heritage could be considered the next step towards a multilayered relationship in which ethical issues are acknowledged.

However, many other issues have not been discussed so far. Who is the eventual owner of a digital reconstruction of heritage; the primary culture of the modeller? What is the value of digital reconstructions other than to rebuild an object? It is clearly not an authentic object, but there has also not been a comprehensive discussion about the course of action with digital replicas in museums. Is it appropriate to reconstruct non-western heritage as a western country - and if not, why? Digital reconstruction is a resourceful solution and interaction with the owner of the original object is usually needed to make a reconstruction. What is, however, the added value of a reconstructed object when the object is not acknowledged as being important by the primary culture? This would lead to the perception that reconstructions are only produced for their appearances, look and to show off

[278] This was a collaboration between the IDA, the Dubai Future Foundation, the University of Oxford UNESCO, Harvard University, the Classics for All Charity and the Abraham Path: "The Triumphal Arch," The Institute for Digital Archaeology, accessed October 8, 2019, http://digitalarchaeology.org.uk/the-triumphal-arch.
[279] Khunti, "The Problem with Printing Palmyra," 7; Kamash, "'Postcard to Palmyra'."; Burch, "A Virtual Oasis," 67; "Should we Celebrate a Replica of the Destroyed Palmyra Arch?," Robert Bevan (Evening Standard Online), updated April 25, 2016, https://www.standard.co.uk/lifestyle/design/should-we-celebrate-a-replica-of-the-destroyed-palmyra-arch-a3233496.html.
[280] Kamash, "'Postcard to Palmyra'," 611.
[281] Ibid., 611.
[282] Kamash, "'Postcard to Palmyra'," 617; Burch, "A Virtual Oasis," 70-72
[283] Khunti, "The Problem with Printing Palmyra," 2.

technological advancements, without an equal partnership with the primary culture.[284] These questions cannot be thoroughly answered at this moment, since the field of study has not touched upon these subjects.[285] It must, however, be noticed that museum are part of this story and should feel obligated to research and communicate about these questions as they are the cultural platforms in society that are able to discuss these issues with the larger audience.

In the exhibition, the bas-reliefs, the reconstructed palace room and the lamassus were made to show, in a concrete way, how cultural heritage that is destroyed could be rebuild. It could be said that the focus was thus on the technology instead of the object itself, although, in their perception, reconstructions should only be used as a device.[286] It is argued by Mol that this could perhaps be prevented if the digital devices were blended into the exhibition itself like with the computer animations.[287] Especially because the heritage room was at the end of the exhibition in which people had already passed by a lot of objects. It would be helpful if the NMA would have researched the effect of digital devices as objects and the visitor opinions of the diverse aspects of the exhibition. In contrast, the museum could also have told another story about destruction without a focus on digital technology; the human side of the story. Their meaning behind objects, the connection to their pasts, the problems they face and their way to preserve the past.[288]

[284] Janowski, “Bringing Back Bamiyan’s Buddhas,” 47.
[285] Angus Mol, Interview, executed 27 September, 2019.
[286] Lucas Petit, Interview, received 1st of October, 2019.
[287] Angus Mol, Interview, executed 27 September, 2019.
[288] Angus Mol, Interview, executed 27 September, 2019.

Conclusion

This thesis aims to investigate the added value of digital reconstruction technology in archaeological museums. This was framed in the research question: How can digital reconstruction techniques and devices be of added value to the transfer of the meaning and content of archaeological objects in archaeological museums?

The first case study incorporated the digital reconstruction of the Regolini-Galassi tomb in Cerveteri and the VR application in the exhibition *Etruscans: Eminent Woman, Powerful Men* in the Allard Pierson Museum. The following questions were asked: Why is it needed for an archaeological museum to digitally reconstruct in general, how did museums transfer information with early immersive digital technology, and lastly, for who and how was this of added value? Based on the analysis of the interviews and literature study, it can be concluded that the digital reconstruction of the Regolini-Galassi tomb was of added value in three ways: for the museum and archaeological research, for the material involved and for the visitors who viewed the application. The digital reconstruction produced the opportunity to reseach the grave gifts in a visual way, creating new conclusions about the relation between the rooms and the location of the accessory objects that was lost since the sale of the objects to the Vatican museums. Practical matters, inconsistencies between sources and details were also discovered through the digital process. Moreover, the process of reconstruction created the opportunity to ask questions about details that were not asked otherwise. Besides, the reconstruction made it able to digitally view the objects and the tomb as a whole as well as increase the accessibility of the material. Lastly, the VR application in the museum was valuable to visitors as it contextualised the objects and enhanced the experience of the visitor in a multi-sensory, immersive and emotional way.

However, during the process of conducting this study, critical notes and limitations appeared. One of the most important conclusions was the undefined expectations between the technicians and the museum professionals. This resulted in a project with no sustainable character; valuable information that will not be used in the future due to the fast replacement of the technology; and discussions about the quality and technical level of the application. Besides, it was recognized that, although the digital reconstruction can be a useful research tool, the publication of 3D visualisations and the missing background behind the creation of a reconstruction was still an unresolved problem. The complex framework of questions and choices the modeller has to make to finalize the reconstruction is difficult to communicate in an application in a museum and was furthermore not seen by the museum as a goal.

Thus, it could be concluded that the digital reconstruction of the Tomb and presentation of the model produced a new way to present archaeological material in a visual and experimental way, which visitors seems to like. It showed, however, also the structural

problems, both scientific and practical problems that are not discussed yet, museums have to deal with when incorporating immersive technology into the museum display.

The second case study was focused on the digital devices and technologies that were used in the exhibition *Nineveh* in the Dutch National Museum of Antiquities. The following questions were asked: Why is it needed for an archaeological museum to reconstruct cultural heritage that is destroyed, how and with which reasons do museums recently transfer information with digital technology, and lastly, how is this changed through time concerning the added value? The exhibition incorporated computer animations, 3D printed bas-reliefs, a coloured reconstruction of Room V of the Southwest Palace and replicated lamassus. The reconstructions and replicas were made to communicate the story about the destruction of world heritage and to create awareness about heritage at risk and the possible solutions to save, protect or rebuild material for future generations. The digital devices and technologies were quite similar to Etruscanning, of added value in three different ways: for archaeological research and the museum, for the material as a part of global cultural heritage and for the public who visited the exhibition. The process of creating digital reconstructions produce opportunities to ask questions and research details that were not known until then, like the colouring of the bas-reliefs. Although they generated new archaeological knowledge in terms of the colours onto the original reliefs, this research was mostly accomplished for the communication of the story to the visitors instead of the new conclusions about the original material. The exhibition had added value for increasing awareness about endangered heritage and the solutions to capture, preserve and rebuild archaeological material. Many objects in the exhibition are currently destroyed or damaged and were resurrected in the exhibition as part of the storyline about cultural heritage at risk. Furthermore, the digital devices were largely intended to educate the visitor and enhance their experience. The digital technology was used to contextualise objects in which they are better understood by the visitor. Besides, the experience of the visitors was expanded by the use of high-tech to show how big and impressive the city was around 700 BCE.

However, the amount of digital technology was not approved by everyone. It has been argued that the digital technology was ‘too much’ as it was distracting and it created a direct link between high-tech technology and cultural heritage at risk, although solutions to this problem can also be sought in other aspects. Comparable to the Etruscanning project, it is viewed that the complex framework of questions and choices the modeller has to make to finalize the reconstruction is still difficult to communicate in a museum. Some technologies are not capable of communicating about this, some are not intended to do this, although it has been a problem for several years. Besides, caution must be taken when making reconstructions as a Western country. Although no ethical problems were viewed in the exhibition; they even produced a sustainable solution for the lamassus by sending them to

Syria after the exhibition, many ethical questions and limitations are not yet answered or discussed by academia or museum professionals. Museums are, however, part of this story and should feel obligated to research and communicate about these questions as they are the institutions that are able to discuss these issues with the larger audience.

Thus, it could be concluded that the digital devices were attractive for the public and helpful for the restoration and promotion of cultural heritage at risk. It could, however, be doubted if all the technology was needed to communicate the story, especially since many questions are still not answered about ethics or accoutability.

In comparison to the first case study, the second case study incorporated much more digital technology in their exhibition. It is assumed that this increase in digital technology is a general development that will also be viewed at other archaeological museum, Dutch or international. Although the added value of digital reconstruction technology in an archaeological museum is argued in his study, no clear answers can yet be made about if a large amount of digital technology is necessary per se. Digital reconstruction technology can be complementary to exhibition practices as it transfers meaning and content in a different way than the ordinary non-digital practices as is seen above. However, the amount of technology that is needed to transfer this content and meaning is not defined. This could lead to discussions wherein it is stated that the technology is 'too much' and changes from device to part of the subject, a development that is generally accepted as negative.

It is observed that institutions pass by several, notwithstanding fundamental, questions while making digital reconstructed archaeological objects.[289] Technology is developing at a fast rate. However, the substantive issues that are accompanied by this are not discussed enough. For instance, what does it mean to humanity that cultural heritage is destroyed? Why are western museum reconstructing cultural heritage that is not theirs? Does the public appreciate digital immersive technology in archaeological museums? What are the terms for using digital devices to be worth the money that is spent on them? All these questions cannot be answered as there is not enough visitor data available or academic debate held, although, gradually, more manuals and frameworks are proposed for the practical use of digital devices in museums.[290] Further research into these questions could be helpful.

In conclusion, it can be argued that digital technology and digital devices are certainly of added value to the archaeological museum, archaeological research, archaeological material and the visitors of archaeological museums. It can be said that the general perception of archaeology in museums will improve as the material will be presented in a more

[289] Angus Mol, Interview, executed 27 September, 2019.
[290] Van Vliet and Schrandt, "Kansen en Keuzestress."

contextualised and interactive way. However, it should also be noted that there is a long way to go to answer and solve all the questions, problems and limitations that are indirectly connected to digital technology in museums. Questions that should be answered by both museums and visitors. It is identified that authenticity is a key concept that is examined as the backbone of many issues. It is viewed in this study that a reconstruction of archaeological material culture is currently true to its contextual / functional value as a museum object to represent past stories. A better understanding of its historical value, it development in time, should however also be more valuated. Digital reconstruction in relation to different authenticities should therefore be better understood to analyse, interpret and initiate new future projects.

Attachments

Appendix 1

What are digital reconstruction technologies, which can or are already used in archaeological museums and how do they work in detail? These questions, i.e. the definition, terminology, description and examples, are useful to understand to know what they can offer for museums. The technology behind the devices, laser scanning and photogrammetry, is not important in this study, but have to be understood to point out the insecurities of reconstruction devices.

What are digital reconstruction technologies and which technological innovations are behind the devices?

Digital reconstructions technologies and digitization, although expected, are not the same. Digitization can be considered an umbrella term for all activities that convert non-digital or analogue data into digital data that can be read and adjusted by electronic devices.[291] In museums, this can include the registration of objects from a physical registration card to a digital record in a database or the booking of tickets online instead of in the museum itself or the transfer of information on the museum website.[292] Digital reconstruction technologies are, in short, techniques that mostly begin with the convertion of 3D physical data into 2D digital data with the help of digitization technology. The method behind this action differs for every technique. The 2D data is converted again to 3D digital visual models with digital modelling tools and software. In other words, the reconstruction of three-dimensional data of real life is translated to three-dimensional digital documentation. In this process, the model can be adapted to correct or supplement the result.

Digital reconstruction has been recognized as an ambiguous term by researchers and can be potentially misunderstood since the description of the term can have several variations.[293] Reconstruction has for instance been described as ".. the construction of a new object, building, or structure, that represents, as closely as possible, a cultural heritage object that has been entirely or partially lost".[294] This excludes consequently non-visual and immaterial cultural heritage and is in this case always based on archaeological, historical, literary, graphic and pictorial evidence.[295] Digital reconstruction is described as "a specific branch of reconstruction, in the sense that it makes use of computers and appropriate

[291] "Digitization," Technopedia, updated 2019, https://www.techopedia.com/definition/6846/digitization.
[292] Carrado and Moulaison Sandy, *Digital Preservation for Libraries, Archives, and Museums.*
[293] Bentkowska-Kafel and Lindsay, *Digital Techniques for Documenting and Preserving Cultural Heritage*, 9, 11-12.
[294] Ibid., 11.
[295] Ibid.

programming language or software to construct digitally, or "fill in the losses and lacunae" of missing digital data, including those of digital representations of cultural heritage objects."[296] The focus on the method - computers and programming language - to create the reconstruction extends the description of the term to a more technical level. The 'filling' of gaps in the model is part of the term, although this is not directly apparent when using it.

The term 'model' can also be differently interpreted. Most models in computer graphics are based on mesh models with polygons that consist of vertices, edges and faces (fig. 1).[297] A face can have three (triangle), four (quad) or more than four vertices (general polygon). When the faces are connected to each other, a 3D model appears (fig. 2 & 3).

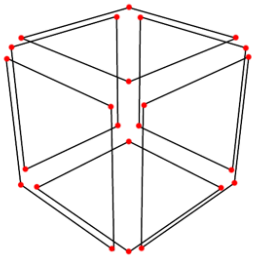

Figure 2: A simple 3D mesh model.

The description of a model according to the book *Using Computers in Archaeology*: "a model is a simplification (which we understand and can manipulate) of an aspect of complex reality (which we don't understand and can't manipulate)".[298] Through accepting that the model is a simplification of real life, the term becomes more flexible for usage.

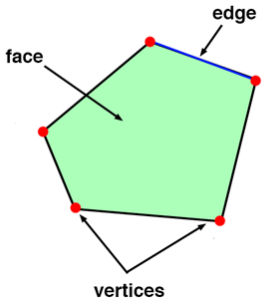

Figure 1: A polygon with vertices, edges and faces.

It has been argued that not all technologies can fit all digitization (reconstruction) projects as cultural heritage sites are very different in characteristics.[299] In the field of archaeology, the use of digital devices as a methodology in an excavation, the research after the excavation or for data storage have been present since 1930.[300] Specialized magazines like *Digital Applications in Archaeology and Cultural Heritage*, *Virtual Archaeology, Journal of Computer Applications in Archaeology* or *Frontiers in Digital Humanities, section Digital Archaeology* have posted many articles about the technology itself and the influence and results of the digital devices in archaeological fieldwork, which has resulted at the moment in

[296] Bentkowska-Kafel and Lindsay. *Digital Techniques for Documenting and Preserving Cultural Heritage*, 12.
[297] "Introduction to Polygon Meshes," Scratchapixel 2.0, accessed July 12, 2019, https://www.scratchapixel.com/lessons/3d-basic-rendering/introduction-polygon-mesh.
[298] Lock, *Using Computers in Archaeology*, 147.
[299] Bentkowska-Kafel and Lindsay. *Digital Techniques for Documenting and Preserving Cultural Heritage*, 197.
[300] Evans and Daly, *Digital Archaeology,* 17.

a bulk of articles about many technologies in combination with different kinds of sites from different periods, cultures and sizes.[301]

In reviewing and analysing the literature, two basic techniques appears as mostly fitting for the selected devices to digitally reconstruct the archaeological material culture in this study: laser scanning and photogrammetry.[302] The main reason behind the extensive use of these particular technologies is their high accuracy, accessible usability and low costs.[303]

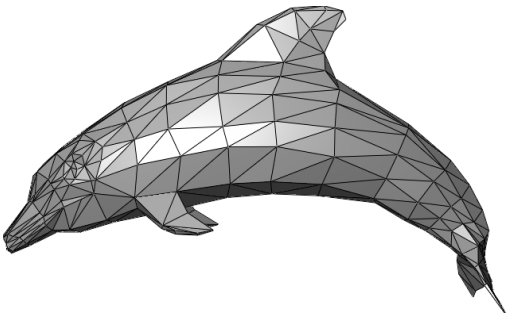

Figure 3: A more complex 3D mesh model.

These three-dimensional survey techniques are part of light-dependent methods of 3D depth sensing (fig. 4).[304] Laser scanning and photogrammetry are active and passive methods which produce point clouds. With the use of 3D modelling software on computers, the point clouds can be converted to 3D models that can be used by the 3D reconstruction devices (Virtual Reality, Augmented Reality, Mixed Reality) to produce attractive and interactive models. When needed, the models can be printed with 3D printing devices, changing the 3D digital model to a physical model again. The basics of laser scanning and photogrammetry will be explained to the extent which is necessary to understand the technology behind the devices in the case studies.

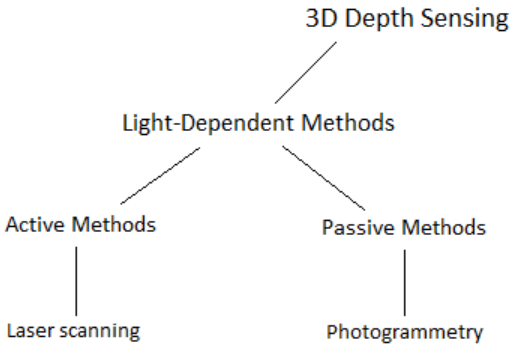

Figure 4: Table of light-dependent methods of 3D depth sensing.

Laser scanning

[301] The journal "Computer Applications in Archaeology" is published since 2018, "Digital Applications in Archaeology and Cultural Heritage" since 2014, "Virtual Archaeology" since 2010 and "Cultural Heritage or Frontiers in Digital Humanities, section Digital Archaeology" since 2007.
[302] There are many more methods to digitize objects, but these were most commonly used in the literature. More methods can be viewed in Bentkowska-Kafel and MacDonald, *Digital Techniques for Documenting and Preserving Cultural Heritage.*
[303] For instance: Wahbeh, Fangi and Nebiker, "Combining Public Domain and Professional Panoramic Imagery for the Accurate and Dense 3D Reconstruction of the Destoryed Bel Temple in Palmyra," 82 ; Campanaro, Landeschi and Dell'Unto, "3D GIS for Cultural Heritage Restoration," 322 ; Barsanti, Remondino, Jiménez Fenández-Palacios and Visintini, "Critical Factors and Guidelines for 3D Surveying and Modelling in Cultural Heritage," 142-143.
[304] 3D Depth Sensing is a system that is able to take measurements i.e. geometric and spectral characteristics from objects in a 3D scene: Bentkowska-Kafel and MacDonald, *Digital Techniques for Documenting and Preserving Cultural Heritage*, 195-196.

A laser scanner is an active measuring device that rapidly pulses beams of light onto a surface or an object.[305] These pulses of light, this can be thousands per second, are rotated by the scanner to scan the whole surface from different angles.[306] By analysing the time it takes for light to bounce back, the distance can been measured. The distance between one reference point and the scanner is called a data point. The assemblance of many of these data points produce a point cloud. These point clouds can produce simple models like a basic model of a Greek vase without decoration or more complex and interpreted models like architectural spaces.[307] It is a non-contact scanning method, which is very suitable for vulnerable objects and can be used for objects for all kinds of sizes.[308]

Laser scanners measures however surfaces, but include no color.[309] This can only be produced in combination with an additional or inbuild calibrated camera to include colour measurements. Many factors like the precision and accuracy of the laser scanner, the advancements of the modelling software, the inclusion of other additional devices and the skills of the designer can influence the quality of the end product.

The development of laser scanning has emerged since the 1960s for engineering, but it was not until 1993 that the first laser scanner was used by surveyors and engineers to create objects in a digital form.[310] It is not fully clear when laser scanning was introduced into archaeology, but the earliest examples are seen in aerial and satellite surveys to search for sites and create elevation models.[311] Through the fast advancement of bandwidth and hard drive storage, laser scanners become progressively economical and therefore easier for all kinds of usage.

An important characteristic of laser scanning is that it can only be conducted when the object is still available, or partly at least in the case of destroyed cultural heritage or scattered parts of an object. The object is needed for making a data point cloud, although much can be interpreted and added later in computer systems like SketchUp or Blender. Laser scanners can be used along with other measuring devices to complement the model.

Photogrammetry

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[305] Renfrew and Bahn, *Archaeology: Theories, Methods and Practice*, 83 ; "What is Laser Scanning?," Bennett and Bennett, accessed 26 April, 2019, https://bennettandbennett.com.au/laserscanning-blog/what-is-laser-scanning/.
[306] Bentkowska-Kafel and MacDonald, *Digital Techniques for Documenting and Preserving Cultural Heritage*, 199.
[307] Campanaro, Landeschi and Dell'Unto, "3D GIS for Cultural Heritage Restoration," 322.
[308] Bentkowska-Kafel and MacDonald, *Digital Techniques for Documenting and Preserving Cultural Heritage*, 199.
[309] Ibid., 199, 201.
[310] "History of Laser Scanning," SurvTechSolutions, updated 2018, http://floridalaserscanning.com/3d-laser-scanning/history-of-laser-scanning/.
[311] Renfrew and Bahn, *Archaeology: Theories, Methods and Practice*, 84-88.

Photogrammetry is a passive technique to obtain metric information i.e. geometry and colour of an object, ranging from little objects to large monuments, through measurements that are processed in photographs and with the use of Structure from Motion.[312] The latter is the principle to indentify and construct geometry by examining the shape by moving around the object involved. The metric data is subtracted from points that are found in the overlap between at least two photos and combined by a process which is called multiple view stereo vision.[313] The more the point is recognized on different photos, the better the computer can calculate the location of the point in 3D. Different kinds of photos such as satellite, airborne, terrestrial but also simple tourist cameras can be used. The generated points with metric data are uploaded in computer systems that converted and combine the information into a 3D models. This procedure is called 'self-calibrating bundle adjustment'. Photogrammetry is a quick and low-cost technique with detailed results.[314] The quality of the model depends mostly on the degree of details in the photos along with some experience of the specialist for good results.[315]

Photogrammetry was a result of four big technological inventions: photography, aeroplanes, computers and electronics and is based on the principles of stereoscopy.[316] The first analogue version of the technology was meant as an aerial surveying and mapping method, but the digital version, emerged around the 1970s, with the possibility of combining digital pictures together has a broader perspective in usability.[317] It can be regarded as the first non-contact measuring method.

Under the condition that there are already photos available, an important advantage of photogrammetry in comparison with laser scanning is that it can still produce models even when the object or monument is gone.[318] A recent and clear example of this is Rekrei.[319] This site started as a organisation to recreate Syrian cultural heritage with photogrammetry in answer to the destruction of many sites in the country. Nowadays it has a broader scope and reconstructs cultural heritage sites and objects from all around the world with the technique.

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[312] "Basics of Photogrammetry," GIS Resources, updated Januari 3, 2014, http://www.gisresources.com/basic-of-photogrammetry_2/ ; Bentkowska-Kafel and MacDonald, *Digital Techniques for Documenting and Preserving Cultural Heritage*, 243.
[313] Bentkowska-Kafel and MacDonald, *Digital Techniques for Documenting and Preserving Cultural Heritage*, 225, 229-230.
[314] Barsanti, Remondino, Jiménez Fenández-Palacios and Visintini, "Critical Factors and Guidelines for 3D Surveying and Modelling in Cultural Heritage," 143.
[315] Barsanti, Remondino, Jiménez Fenández-Palacios and Visintini, "Critical Factors and Guidelines for 3D Surveying and Modelling in Cultural Heritage," 148.
[316] Schenk, *Introduction to Photogrammetry*, 8-10 ; Bentkowska-Kafel and MacDonald, *Digital Techniques for Documenting and Preserving Cultural Heritage*, 230.
[317] Schenk, *Introduction to Photogrammetry*, 8-10
[318] Wahbeh, Fangi and Nebiker, "Combining Public Domain and Professional Panoramic Imagery for the Accurate and Dense 3D Reconstruction of the Destoryed Bel Temple in Palmyra," 82 ; "Home," Rekrei, accessed April 26, 2019, https://projectmosul.org/.
[319] "Home," Rekrei, accessed April 26, 2019, https://projectmosul.org/.

The decision which 3D depth sensing technology to use depends on a few aspects. These can be technical like accuracy and precision, but also aspects of management like time, budget or access restrictions.[320] For instance, although they produce higher accurate 3D models, laser scanners have higher costs for the instruments than photogrammetry.[321] This can influence the choice of method for digitizing objects.

Which digital reconstruction devices can or are already used in archaeological museums and how do they work in detail?

The devices that have already been used in museums are 2D reconstruction with modelling software, Virtual Reality (VR), Augmented Reality (AR) and 3D printing. These tools are commonly used and it has been argued that most have the potential to enhance the practices of museums to a great extent.[322] The technology will be explained as detailed as is necessary to understand how the devices operate and in which cases they can be used. To explain the technologies, first, the Reality - Virtuality continuum principle has to be described in order to make sense of the spectrum of realities between the virtual and real world.

This continuum is described by Milgram and Kishino in 1994 and is visualised by a diagram "virtuality continuum".[323] The real world is opposite to the virtual world. In between are the immersive realities: augmented reality (AR), augmented virtuality (AV) and mixed reality (MR). AR is closer to the real world and supplement reality with virtual information. AV is closer to the virtual world and augments the virtual world with information of the real world. MR can span from one to the other side, blending virtual and non-virtual elements within an environment.

2D reconstruction with modelling software

This method is, shortly said, a virtual three dimensional image on a 2D flat screen like that of a display, TV screen or mobile phone. This is the most basic way of showing digital imagery in which visitors can look at the screen to view a model in a virtual environment. This image can be 2D in the case of a photo or in 3D in the case of a 3D simulation. The 3D model can

[320] Bentkowska-Kafel and MacDonald, *Digital Techniques for Documenting and Preserving Cultural Heritage*, 197.
[321] Barsanti, Remondino, Jiménez Fenández-Palacios and Visintini, "Critical Factors and Guidelines for 3D Surveying and Modelling in Cultural Heritage," 143.
[322] "How Museums are using Augmented Reality," MuseumNext, updated February 7, 2019, https://www.museumnext.com/2019/02/how-museums-are-using-augmented-reality/ ; "How are Some of the World's Best Known Museum doing Amazing Things with 3D Printing?," updated February 1, 2019, https://www.museumnext.com/2019/02/how-museums-are-using-3d-printing/.
[323] Milgram and Kishino, "A Taxonomy of Mixed Reality Visual Displays,"2-4; Bekele, Pierdicca, Malinverni and Gain, "A Survey of Augmented, Virtual, and Mixed Reality for Cultural Heritage," 3-4.

be made with modelling software like Blender, Maya, Adobe Autodesk, Cinema 4D, Computer-Aided Design (CAD) systems and Geographical Information Systems (GIS), although some software is more appropriate for certain tasks than others.[324]

The incorporation of digital media, also covered by the term New Media, into the museums dates back to analogue dioramas and tableaux around the late nineteenth century and further developed around mid twentieth century with the introduction of interactive display techniques with virtual environments.[325] The Deutsches Museum in Munich experimented for instance with film in 1907 and the Hall of Biodiversity which was opened in 1998 had interactive touch screens and screens for video clips which complemented the objects in the exhibition.[326] Digital technology in museum displays advanced by the ability to show invisible and intangible objects, stories and concepts. Eventually, digital display technologies are often used nowadays in the design of an exhibition due to its visual benefits, easy use and decreasing costs.

Virtual Reality

VR is an artificial reality; a computer-created virtual environment in which the user is immersed into the virtual world. 2D reconstruction with 3D modelling is almost the same, but the difference is that the first is fixed to a certain place in a room with a screen and VR is observed through glasses or a screen and can be moved. The experience is thus created by a screen of a smartphone that is incorporated into specialised VR gear or with VR glasses. Additional dimensions like audio, smell and touch can be added to the technology by incorporating these elements in the VR model and physically adding them in the real world.[327] Also storytelling can be added to "..breathe life .." into the model.[328] A VR model is created by virtual environment modelling which is ".. the process of simulating real objects and their state in a digital space, the behavioural rules that the objects obey, and the relationship and interactions between them".[329]

In its early development, the possibilities for VR were expensive and limited. The introduction of the Oculus Rift in 2014 gave VR a boost to emerge and attracted names like

[324] Adobe has besides programme's like Illustrator for vector illustrations, Photoshop and Lightroom for editing photo's and Fuse (Bèta) for editing images to 3D models: "Creative Cloud - Alle Apps," Adobe, updated 2019, https://www.adobe.com/nl/creativecloud/catalog/desktop.html ; The difference between CAD and GIS is explained in: Lock, *Using Computers in Archaeology*, 53-54.
[325] Henning, "New Media," 303-306.
[326] Henning, "New Media," 304; Witcomb, "Towards a Pedagogy of Feeling, Understanding How Museums Create a Space for Cross-Cultural Encounters," 353.
[327] "Wat is Virtual Reality?," Samsung, updated 2019, https://www.samsung.com/nl/i/vr/wat-is-virtual-reality/.
[328] Rizvic, "How to Breathe Life into Cultural Heritage 3D Reconstructions," 49.
[329] Bekele, Pierdicca, Malinverni and Gain, "A Survey of Augmented, Virtual, and Mixed Reality for Cultural Heritage," 7.

Google and Facebook.[330] At first, VR was mostly used for games or simulation for military purposes, but the technology has expanded also to the cultural heritage sector.[331]

VR has still enough challenges to face. VR can cause motion sickness caused by the latency between the movement of the head and the movement of the video on the screen.[332] The choice of tracking system can influence the speed and accuracy of the image.[333] The resolution of the models can in some cases be considered simplistic, the technology lacks standards and it is considered as gimmickry.[334] Besides, VR eliminates reality, thus withdrawing the user from its actual environment which can cause problems like unintentionally pushing an object or bumping into other people.

Augmented Reality

AR, briefly speaking, is a method to fuse digital elements into reality in which the user can see both actual and virtual objects in the same moment.[335] The digital model can be observed through a screen of for instance a smartphone or a tablet with a camera or sensor or through the use of AR glasses. " .. an Augmented Reality application allows a user to navigate in a real environment with an augmented visualization of synthetic elements".[336] The user is thus directly connected to reality instead of a virtual space with VR.

The term Augmented Reality was coined by Tom Caudell in 1990 and became popular around 2000.[337] The possibilities are broad at the moment, although not yet fully explored. At the time of writing AR will lay flat images over the spatial environment, but with the use of a 'Hololens' depth has been added to the dimension registration of AR. This additional function has first been called Mixed Reality, although it can now also be considered AR. The precision and completeness are flexible elements in the process and the level of visual persuasion can

[330] "Virtual Reality; Alles Wat Je Moet Weten," VR Expert, updated March 15, 2015, https://vr-expert.nl/blog/virtual-reality/.
[331] Bekele, Pierdicca, Malinverni and Gain, "A Survey of Augmented, Virtual, and Mixed Reality for Cultural Heritage," 4.
[332] "Virtual Reality; Alles Wat Je Moet Weten," VR Expert, updated March 15, 2015, https://vr-expert.nl/blog/virtual-reality/.
[333] Bekele, Pierdicca, Malinverni and Gain, "A Survey of Augmented, Virtual, and Mixed Reality for Cultural Heritage," 5- 7.
[334] "Issues and Challanges," Virtual Reality, updated 2017, https://channels.theinnovationenterprise.com/articles/5-major-challenges-of-vr-industry; http://web.tecnico.ulisboa.pt/ist188480/cmul/issues.html.
[335] "Wat is Augmented Reality," AR Experts, updated May 3, 2018, https://ar-experts.nl/kennisbank/wat-is-augmented-reality/ ; Bentkowska-Kafel and MacDonald, *Digital Techniques for Documenting and Preserving Cultural Heritage*, 207.
[336] Bentkowska-Kafel and MacDonald, *Digital Techniques for Documenting and Preserving Cultural Heritage*, 207.
[337] "Augmented Reality Issues - What You Need To Know," The App Solutions, updated 2018, https://theappsolutions.com/blog/development/augmented-reality-challenges/.

differ per model.[338] Known examples of companies that made the use of AR a hype is Pokémon Go and Snapchat.

The challenges that are present with this technology are in the principles of co-localization, co-occlusion and co-lighting.[339] Co-localization is the correct alignment of reality with the virtual elements that are blended in by the use of computer vision techniques like GPS and depth cameras. Co-occlusion is the occlusion of the virtual elements into the geometry of reality by the use of scanners and depth cameras. Co-lighting is the rendering of light interaction between virtual and actual elements into the scene. This is one of the most complex challenges at the moment as it demands a continued change of the model to follow the correct shading and light incidence of every moment of the day. Another challenge, or problem, is the fact that AR is still at its infancy. Standards in the software are still under construction for the technology, issues with privacy and security are not yet known to everyone, the flowering of AR projects are usually short-term and independent of a long-term collective development and the quality is in most cases simplistic and lacks expertise.[340] Admitted, some of these challenges, also with VR, are rather short-term problems which can be decomposed or solved when taking a closer look at them.

In the cultural heritage sector, AR can be used by archaeologists and museums as a tool to visualise, reconstruct, understand and analyse cultural heritage in a spatial way and for the purpose of education.[341]

3D printing

3D printing is an additive manufacturing technique that produces a model by building up layers on top of each other.[342] 3D printers can produce parts of almost every geometry. The basic process begins with the production of a 3D file by photogrammetry, laser scanning or with a CAD programme. The file has to be converted into a format that a 3D printer can interpret (STL). The file is then sent to the 3D printer and printed. Depending on the 3D printer, some post-processing procedures like the removal of its building platform have to be fulfilled to finish the end product.

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[338] Bentkowska-Kafel and MacDonald, *Digital Techniques for Documenting and Preserving Cultural Heritage*, 207.
[339] Bentkowska-Kafel and MacDonald, *Digital Techniques for Documenting and Preserving Cultural Heritage*, 207-208.
[340] "Augmented Reality Issues - What You Need To Know," The App Solutions, updated 2018, https://theappsolutions.com/blog/development/augmented-reality-challenges/.
[341] Bentkowska-Kafel and MacDonald, *Digital Techniques for Documenting and Preserving Cultural Heritage*, 209 ; "Toepassingen van Augmented Reality," VR Webwinkel, updated 2019, https://vrwebwinkel.nl/toepassingen-van-augmented-reality/.
[342] Redwood, Garret and Schöffer, *The 3D Printing Handbook*, 9.

One of the first printers was developed between 1981 and 1999 by the invention of stereolithography and by the use of photopolymers.[343] The RepRap project in 2005 that could print its own parts and the first Selective Laser Sintering (SLS) machine in 2006 made it able to democratize and commercialize the printers for the public.[344] Nowadays, an amplitude of objects of different sizes can be created like architectural objects, historical objects, organs, jewellery, food or parts for furniture.

A limitation of a 3D printer is its inability to produce models with all types of materials, although this is rapidly changing. In 2017, these material incorporated polymers, thermoplastics, thermosets, metal, sands and others like ceramics or composites with ceramics, glass, carbon, aluminium, graphite, wood and metal, but also biodegradable materials with starch, rubbery materials, paper, sugar, chocolate and other food or composites with chalk or salt have been added to this list at the time of writing.[345] Limited repeatability has also been described as a limitation as the process of cooling and warping can cause variations between the models.[346] Besides, the impact of the use of plastics has an effect on our health and environment, the printing requires a huge amount of energy, it causes unemployment as the machines absorb the need for humans by automatization and small limitations due to the infancy of the technology are still challenges to overcome.[347]

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[343] “History of 3D Printing: It’s Older Than You Are (That Is, If You’re Under 30),” Autodesk (Redshift), updated April 13, 2018, https://www.autodesk.com/redshift/history-of-3d-printing/.
[344] “History of 3D Printing: It’s Older Than You Are (That Is, If You’re Under 30),” Autodesk (Redshift), updated April 13, 2018, https://www.autodesk.com/redshift/history-of-3d-printing/.
[345] Redwood et al. *The 3D Printing Handbook*, 21-22; “3D-print Materialen,” Ground3D, accessed June 28, 2019, http://www.ground3d.nl/over-3d-printen/wat-kun-je-3d-printen/.
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Interviews

- Interview Wim Hupperetz, executed 25 September, 2019. (37:40 min)

Annotation: While writing out the interview, some colloquial language will be changed to written language to make the text more easy to read. I, the interviewer, will be indicated as 'I' and Wim, as the respondent, will be indicated as 'R'.

The interviewee: Wim Hupperetz is heritage specialist in the field of museology, (Roman and late medieval) archaeology, castles, housing culture, cultural landscapes and urban environments, and is interested in digital and virtual media. He is currently the director of the Allard Pierson Museum in Amsterdam.

I: Heeft u er iets op tegen dat dit interview wordt opgenomen? Het interview moet uiteindelijk worden uitgeschreven en een geluidsfragment van dit gesprek zou hier zeer bij helpen. Het geluidsfragement wordt na het notuleren verwijderd.

* *Toestemming ontvangen*

I: Ik heb een paar vragen voor u. De eerste twee vragen zijn algemeen over wat uw mening is over waarom het nodig is om als archeologisch museum archeologisch materiaal en processen te reconstrueren?
R: Je zei het net zelf al een beetje, wij zitten met heel veel objecten die je eigenlijk alleen maar begrijpt binnen een bepaalde context. Het zijn geen autonome kunstwerken, dus ze zijn niet gemaakt om op zichzelf mooi te vinden, of als met een schilderij, daar zit zelfs een betekenis achter of een verhaal. Dus wat dat betreft, zit je ook nog eens een keer met fragmentarische objecten, vaak uit een hele andere tijd, waar we ons moeilijk in kunnen verplaatsen. Dus die objecten hebben die context nodig. Die kun je aanrijken in tekst, die kun je aanrijken in plaatjes of in videos, maar het werkt vaak, zeker in onze beeldcultuur, sterker als je zo'n object 3D reconstrueert en ook in een 3D context als het ware laat functioneren, zodat de betekenis duidelijk wordt. Dus dat is waarom wij, ik noem het meer visual storytelling, nodig hebben.

I: Dus het is meer het proces van het overbrengen van de context, dus educatief?
R: Ja, het is heel educatief. Naja, goed, museum ervaring kan op esthetiek de nadruk leggen, maar dan ga je meer naar kunstmusea. Bij historisch en archeologisch musea leg je toch vaak de nadruk op dat je iets leert, dat je iets ervaart. Dat kan een Wauw-effect hebben of een Aha effect. Hier zijn allerlei gradaties van. Maar dat je uiteindelijk anders tegen het object aankijkt. En vaak, dat is nu vooral in deze tijd is dat een interessante discussie, dat we weten dat een object niet één betekenis heeft, maar vaak meerdere lagen van betekenissen heeft, een soort meerstemmigheid. Die kun je vaak ook in zo'n 3D reconstructie kun je verschillende lagen, bijna letterlijk laten zien.

I: Gefocused op gevoelswaarde?
R: Het kan een verzamelaarswaarde hebben, een wetenschappelijke waarde, het kan een verhaal vertellen van post-koloniale tijd, het kan een verhaal vertellen over het gebruikt, over hoe het gemaakt is, hoe het weggegooid is. Er zitten allerlei perspectieven aan vast. Dat maakt het ook ingewikkeld. Maargoed, die 3D reconstructie, het visual storytelling, kan wel een middel zijn om daar meer duidelijkheid in te brengen.

I: Ja, want mijn vraag daarna was: hoe spelen digitale middelen in het algemeen hier een rol in? Is het een middel?
R: Ja, het is echt een middel, het is geen doel opzich. Dan loopt het toch vaak ook niet. Je ziet steeds meer, dat is toch wel een belangrijk inzicht dat ik zelf heb opgedaan, dat gaat om die meerwaarde, want er toch een soort spanning op het maken van 3D reconstructies en die laten zien in een museum. Als je bijvoorbeeld naar het Rijksmuseum gaat, dan zie je nergens beelschermen. Mensen nemen soms wel een Ipad mee, maar in de tentoonstelling is alles.. er is een audiotour of een Ipad die je meekrijgt, maar verder geen projecties. Dat komt omdat die collectie dat ook niet nodig heeft. In een archeologisch museum met een archeologische collectie zit je veel meer met objecten die niet zo sprekend zijn. Maar dan is er wel een spanning, als je een beeldscherm neerzet, dan kijken mensen naar het beeldscherm en niet naar het origineel. En wil je dat? Dus daar moet je een balans in vinden. En je moet kijken naar wat is de toegevoegde waarde van die visuele bron die je dan aanrijkt. Je hebt nu natuurlijk de combi van augmented reality, waarbij je, en daar ben ik zelf heel erg van gecharmeerd, dat je als het ware een object hebt in een vitrine, je doet er een glasplaat voor en je projecteert op die glasplaat en op het object en dan heb je het allebij. Dan kun je nog steeds switsen, maar je begint met het origineel en je projecteert een 3D model erover en dan laat je de animatie zien hoe dat object qua iconografie of qua whatever welke aspect je wilt benadrukken, zich heeft ontwikkeld.

I: Er zijn inderdaad wel interessante ontwikkelingen.
R: Ja en dat is denk ik ook waar we steeds meer naartoe zouden moeten. Dan heb je het beste van twee werelden.

I: Ja, en dan specifiek over de Etruskenscanning. Het is natuurlijk al een tijdje geleden, en niet meer up to date. Maar ik heb hem wel als case study gekozen, omdat het wel een heel goed voorbeeld was vond ik.
R: Ja, het was een heel interessant project. Je ziet ook wel hoe technologie, hoe snel dat zich ontwikkeld. Dat was echt toen Kinect booming was. Je ziet het nu niet meer zoveel.

I: Dat is nu alweer vervangen?

R: Ja, het was de tijd van de Wii. Kun je dat nog herinneren? Wij hadden dat thuis ook. Ik zie het nu niet meer zoveel. Ik weet niet of het nog uberhaüpt bestaat, maar toen was het 'natural interaction'. Ik vond het niet zo natural, want je moest hele rare dingen doen met je armen, maar dat was toen de grote trend. En het grappige is, we hebben toen die Etruskententoonstelling, die is toen bij ons geopend, en daarna is hij naar Tongeren gegaan. Ze hebben eigenlijk die applicatie die ze bij ons hebben gemaakt, die hebben ze nog doorontwikkeld. En het typische vind ik, die doorontwikkeling was geen succes. De originele simpele applicatie die we hadden, die was het meest krachtig vond ik zelf.

I: Want waarom was die ander geen succes?
R: Je moet je voorstellen. De eerste versie was op een grote projectiewand, in een vierkante ruimte met een plattegrond van een Etruskisch graf. En dan had je een stuk of 5 hotspots. Elke keer als je op een hotspot ging staan, dan ging het cameraperspectief van de 3D reconstructie bewoog met je mee. Je liep als het ware in dat graf. Dat was super simpel, super effectief. Je maakte gewoon een stap en dan bewoog het mee. In de tweede versie gingen ze de armen meenemen. Dan kon je draaien, je kon meer, maar het werd er ook ingewikkelder van. Mensen raakte toch wel heel snel gedesorienteerd. Dus die extra features zijn mooi, en dat is ook een valkuil voor die techneuten. Die zien extra features, die gaan er gelijk mee aan de slag, al was het daar als project ook wel voor bedoeld, maar de usability is natuurlijk ook een ding. Het draait misschien nog steeds wel in het Vaticaans Museum, maar ik ben er al een paar jaar niet meer geweest. We hebben dit volgensmij in 2010 bij ons neergezet en heeft tot 2011 gedraaid. Later hebben we het nog een keer in het Digital Museum Lab opgesteld. Maar in 2011 besloot het Vaticaans Museum, waar de Italiaanse partner wel goeie contacten mee had, om het op te nemen in de vast opstelling. Ergens in een hoekje, met een scherm en Kinect en misschien draait het daar nog wel. Ze hebben er zelf in geïnvesteed. De spullen uit het graf die staan in het Museum. Het was niet in dezelfde ruimte, maar er was wel een verwijzing naar. Er is een heel blog gemaakt. Ken je die? Van Daniel Pletinckx. Die is nog wel online geloof ik.

* *Blog wordt laten zien en bekeken:* https://regolinigalassi.wordpress.com/

R: We hebben in dat project, het was een tweejarig Europees project, zouden we een reconstructie maken van het Regolini-Galassi graf en ook nog het Monte Michele graf. Dat was vlakbij Rome. Hier zat ik ineens naast de directeur van het Vaticaanse Museum en Maurizio Sannibale, de curator.

I: De volgende vraag was: welke rol speelde het *Etruscanning*-project binnen de tentoonstelling *Etruscans. Eminent Woman, Powerful Men*?
R: Het was in die zin interessant, omdat we die objecten wilde laten zien. En het interessante was dat de conservator Maurizio Sannibale, die was al een paar jaar bezig om die objecten te publiceren. Hij is van oorsprong kunsthistoricus en archeoloog, maar we kwamen er achter, toen wij dat plan hadden om dat graf te reconstrueren dat in de 19e eeuw was ontdekt en waarvan tekeningen van gemaakt zijn, dat hij nog nooit in het graf zelf was geweest. Het was een half uurtje met de bus. Toen we de kick-off hadden van het project, toen gingen we naar het graf en je zag hem rondkijken zo van 'het is toch wel klein'. Toen ze het gingen scannen, toen kwamen we er achter dat die tekeningen uit de 19e eeuw niet alles documenteerde. Uiteindelijk hebben we met de reconstructie onderzoekstechnisch iets bijgedragen. Dat was mooi. Aan de andere kant hebben we ook de bezoekers een extra beleving gegeven, omdat je op die manier toch op een hele andere manier zo'n graf beleeft en de objecten die je in de tentoonstelling zag meer context kon geven. Christie Ray heeft daar een klein paper over geschreven, waarbij op vrij simpele manier dat is geankuteerd. Blijkt dat de Etruscanning ook echt wel voor de bezoekers een meerwaarde had, dus dat was mooi. Het frustrerende was wel dat die technologie, die doorontwikkeling en ik zag dat al vrij snel en dat heb ik later ook nog gemerkt in een ander project, dat leverde niet meer op. In tegendeel, het werd eigenlijk ingewikkelder en, je moet me maar corrigeren als het niet zo is, maar je ziet bijna nergens meer het Kinect. Dat zegt uiteindelijk toch wel iets over dat het toch niet is wat mensen waarderen.

I: Je ziet een beetje dat we allemaal een beetje doorslaan in dat we maar die technieken moeten gebruiken, omdat het verwacht wordt. Maar dat is nog maar de vraag, wordt het echt verwacht?
R: Volgensmij niet. En de Wauw-factor is er een beetje van af. En het heeft geen Aha-effect. Ik maak altijd een onderscheid tussen die twee.

I: Wat is dat Wauw-effect?
R: Bij het Wauw-effect dan wil iedereen het, iedereen wil meedoen, dan is het een hype, maar die gaat weer over. En als er dan niks overblijft.. Augmented reality vind ik wel een Aha-effect hebben. Dan zie je uiteindelijk dat er iets blijft hangen.

I: Dus als u het nog een keer zou doen, dan zou u eerder augmented reality gebruiken?
R: Ja, daar zijn we ook mee bezig. Ik zal even kijken of ik daar iets van kan laten zien, op youtube

I: Want hoe lang heeft de applicatie uiteindelijk hier gestaan?
R: Ik denk 6 maanden in de tentoonstelling en toen heeft het daarna ook nog in Tongeren gestaan, de tentoonstelling. En een tijdje in het Digital Museum Lab.

I: Is het Digital Museum Lab er nog steeds?
R: Nee. Dat is er wel lang geweest, maar op een gegeven moment was die ruimte nodig voor iets anders.

* *Filmpje over Crossroads tentoonstelling met kleurenreconstructie wordt laten zien:* https://www.youtube.com/watch?v=tmM1MzVvMp0

R: Dat was ook wel iets. Maar de ellende was dat de techneuten de applicatie niet open maakte aan de achterkant. Dat bouwde ze helemaal dicht en daar konden wij dan niet bij.

I: Hoe bedoelt u?
R: Als je dit wilt aanpassen, dan moet er een CMS achter zitten wat hem toegankelijk is, en dat was er niet.

I: Want dit wordt gewoon door een bedrijf gemaakt en dan krijgen jullie het en dan 'doen jullie het er maar mee' om het zomaar te zeggen?
R: Ja inderdaad.

I: Heeft u er wel invloed op?
R: Dat is een kwestie van opdrachtgeverschap. Nu zijn we bijvoorbeeld bezig met digitale content. En het is mijn strategie, ik wil alleen digitale content die we zelf kunnen beheren. Anders dan is het na 2 a 3 jaar dood en dan is het een zinloze investering. Bij een tentoonstelling kun je dat nog overwegen, maar als je een permanente opstelling maakt, dan wil je dat niet. Daar zijn we nu ook mee bezig. We werken nog steeds met veel 3D modellen: we hebben er nu een paar daaien op de romeinse afdeling. Aan de achterkant worden deze helemaal beheert door conservatoren. Dat vind ik wel een wezelijke voorwaarde om hier echt mee verder te kunnen gaan. Dan heeft het ook een duurzaam karakter.

I: Was dit ook zo bij de Etruscanning?
R: Nee, daarbij was de klassieke manier: je hebt technische partners die nog aan het experimenteren zijn en die zorgen dat het draait qua software en hardware. En dat is mooi als experiment, maar in een museum moeten we iets hebben wat hufterproof is en waar we zelf ook bij kunnen en dat we niet afhankelijk zijn van externen. En dat is best wel een ding. Maar hier moet je zelf ook mensen in mee krijgen. Dat ze denken in dat medium en je moet zelf infrastructuur hebben.

I: Er is dus geen persoon binnen het museum die verantwoordelijk is voor digitale technieken?
R: We hebben we een digital curator. We hebben ook een hardware leverancier en nu ook een software leverancier. Dus we zijn dat we beter aan het organiseren.

* *Tijdlijn Crossroads met 3D scans laten zien: Site not traceable*

I: En wat staat er bij de ontwikkeling van zoiets heel erg voorop?
R: Voorop staat dat we de digital content zelf kunnen beheren, want dit maken is allemaal leuk, maar ..

I: maar hoe staat bijvoorbeeld de presentatie en de kwaliteit tegenover elkaar?
R: Kijk, die 3D modellen worden steeds beter en je kunt dus navigeren met tijd, maar ook navigeren met een kaart. Die 3D modellen draaien allemaal via SketchFab, dus de content moet kloppen, de beschrijving moet kloppen en je moet ze thematisch verbinden. Maar op deze manier zit je weer op een scherm te kijken. Het doel is met de objecten die in de zaal staan, dat die terugkomen, maar dat je ook verbindingen kunt maken met andere objecten.

I: Want dit [*de Crossroads Timeline app/site*] is dan een app die je kan gebruiken tijdens de tentoonstelling?
R: Er staan in onze tentoonstellingen en op de semi permanente afdelingen staan er touchtables. Die hoeven niet zo dominant te zijn en daar kun je dus een beetje surfen in de sleutel objecten en je kan ook kijken naar andere regio's, dus dat is wel interessant. En er zijn ook nog gidsen. Maar we dwalen een beetje af.

I: Wat waren de belangrijkste aspecten waarop gelet werd in het process van het maken van de digitale reconstructie(s)?
R: Het moest natuurlijk wetenschappelijk correct zijn. Je bent best wel doelgericht, je moest uiteindelijk werken naar een applicatie die gebruiksvriendelijk is. Het moet binnen de tijd en het budget passen. Je zit best wel met wat ingewikkelde factoren. Maar waar heel weinig dus op gelet is, is duurzaamheid. Je hebt de tentoonstelling, dan wil je iets laten zien. Dan moet het draaien als het open is en wat daarna gebeurd, dat is in het proces veel minder meegenomen. Dat is wat we nu veel meer op de voorgrond stellen. Het moet uiteindelijk wel een duurzame investering zijn.

I: Dit zie je best wel veel terug, dat veel projecten maar van korte duur zijn.
R: Ja en ik vraag me af, bijvoorbeeld er worden nog steeds allerlei apps gemaakt en ik heb nog nooit echt betrouwbare informatie gezien over het gebruik van die apps. Dus dat is wel een ding. Ik geloof wel dat de Rijksmuseum app wel werkt en dat zie je ook. Maar dingen die je moet downloaden, ze zijn in best wel grote aantallen en er is best wel veel in geinvesteerd, maar ook daar is het elke keer de vraag hoe het verbonden is met de museale praktijken. Dat is wel een opgave. Overigens, als we echt een stap verder willen komen: ik hanteer daarvoor een driehoek met aan de ene kant de digital libraries met ADLIB en alle systemen waar al best veel metadata in zit. Dan heb je de kennis die bij de curatoren zit en je hebt de wereld van de visual storytelling, de 3D ICT bedrijven. En die driehoek is eigenlijk niet goed verbonden. De metadata in de systemen moeten verrijkt worden met wat er in de hoofden van de curatoren zit, zoals de naratieven en de perspectieven. De metadata zijn vaak heel zakelijk. Die conservatoren moeten veel meer leren te denken in de wereld van visual storytelling. En de wereld van visual storytelling moet weer toegang krijgen tot de metadata. Dus als we die driehoek niet beter verbinden, dan komen we niet verder. Dat is mijn overtuiging. Dus als ik projecten doe, dan wil ik die drie partijen aan boord hebben. Dan moet je dus kijken of je digital repositories kunt maken voor die verrijkte gegevens, dan moet je met museum camps de praktijk van de conservators te veranderen en dan moet je systemen maken die goed te beheren zijn en met linked open data werken. Uiteindelijk is dat de les die ik daarvan heb

geleerd. Als je tien jaar met dit soort projecten bezig meekijkt, ook bij Etruscanning, dan zie je een heleboel dingen die heel mooi beginnen, maar in schoonheid sterven, omdat er niet wordt nagedacht over duurzaamheid. En dat is vaak ook niet het belang van het project. Het staat in elk Europees project, wordt het genoemd dan moet je er iets over zeggen, maar na vier jaar dan rent iedereen weg, want dan is het geld op. Zo wil ik niet meer werken, dus wij zitten nu heel strategisch te kijken naar iets zoals als de Crossroads timeline als tool, als curatoriale tool voor digital curating. En dat ziet er wel goed uit. Ik wil niet zeggen dat dit de definitieve oplossing is, maar het is wel een stap in de goede richting.

I: Ik weet niet hoeveel budget er was, maar als u kijkt naar het budget wat jullie als museum ervoor uit moesten geven tegenover het product dat u ervoor kreeg, de Etruscanning..?
R: Dat was best wel een groot prijs-kwaliteit verhouding. We hebben met heel weinig geld, echt wel iets heel bijzonders neergezet. Alleen het was voor die tentoonstellingen en misschien draait het nog steeds en ook in Villa Julia, daar daait die andere applicatie. Dus meestal hebben dit soort projecten dat het na een paar jaar weg is. En dat is hier niet het geval. Alleen op een gegeven moment gaat het verloren. Ik weet niet waar alle 3D modellen zijn opgeslagen. Grote kans is dat over vijf jaar er weer een team naar het graf gaat en het helemaal opnieuw gaat doen. Terwijl je juist op zo'n 3D model wilt voortborduren. Dus het publiceren van die 3D modellen is ook een groot probleem. Er zijn wel manieren voor, maar het is nog niet perfect. Eigenlijk is het zo dat bij een 3D model, als je het niet publiceert, dan heb je geen wetenschappelijk resultaat, omdat je het niet toegankelijk maakt voor de discourse. Je kunt er niet naar verwijzen en niet annoteren. Dus dat is nog steeds een groot probleem. Het publiceren van al de 3D modellen op SketchFab is wel al een stap vooruit, maar dat is een commercieel platform. Dus als daar de stekker uitgaat, dan is het platform gesloten. Dat is wel een risico.
I: Was de digitale technologie een deel van de inhoud van de tentoonstelling of was het alleen een middel? Ik had in de publicatie wel gezien dat de Etruscanning ook een deel het bekijken van nieuwe presentatie middelen was voor in musea, dus dan kan je zeggen dat de techniek ook onderdeel was.
R: Ja zeker, we hebben daar wel naar gekeken en getest. Het is een mix van documenten en kijken naar hoe de navigatie het beste werkt voor een zo goed mogelijke bezoekerservaring.

I: Maar het was dus geen deel van de inhoud van het verhaal van de tentoonstelling? De Etruscanning en de technieken, of dat een deel van de content was van de tentoonstelling of dat het een project was wat uiteindelijk een middel is geworden voor de tentoonstelling?
R: Het zat vanaf het begin in het ontwerp. We hebben gekeken naar waar die presentatie het beste tot zijn recht zou komen. We hebben de verbinding gelegd tussen de objecten en de originelen. Dus het is wel een integraal onderdeel geweest, meer dan vaak het geval is, van de hele tentoonstelling. Moet wel eerlijk zijn, als we niet de Europese subsidie niet hadden gehad, dan was het niet door gegaan. Dus zo pragmatisch is het ook.

I: Mijn laatste vraag was: was de VR-applicatie op dat moment de beste optie als digitaal reconstructie middel?
R: Ja, daar was iedereen best wel van onder de indruk. En ik zei al, de eerste versie was gewoon de beste in zijn eenvoud. Die werkte en draaide redelijk stabiel.

I: Augmented reality was toen al wel een beetje, maar nog niet heel populair.
R: Het was er wel, maar dit was wel state of the art denk ik. Ook de kwaliteit was behoorlijk goed. Je kunt het nu niet meer vergelijken, want 2011/ 2010..

I: Want het had geen VR bril toch?
R: Nee. Soms hadden mensen wel wat misselijkheid. Dit is niet zoveel gezien. Heel veel mensen vonden het leuk om te kijken, hoe iemand navigeerde. En zat geen audio bij. Later kon je ook nog een taal kiezen. En later kwamen er dingen waarbij je kon aanklikken, maar dat was too much.

- Interview Patricia Lulof, executed 25 September, 2019. (33:57)

Annotation: While writing out the interview, some colloquial language will be changed to written language to make the text more easy to read. I, the interviewer, will be indicated as 'I' and Patricia, as the respondent, will be indicated as 'R'.

The interviewee: Patricia Lulof is associate professor of Classical and Mediterranean Archaeology of the University of Amsterdam, specialised in Pre-Roman Archaeology and Archaic roofs, architecture (especially architectural terracottas and decorative roof systems) and (digital) building techniques. She is director of (R)MA Studies of ACASA and scientific director of the 4D Research Lab of the Faculty of Humanties at UvA.

I: Heeft u er iets op tegen dat dit interview wordt opgenomen? Het interview moet uiteindelijk worden uitgeschreven en een geluidsfragment van dit gesprek zou hier zeer bij helpen. Het geluidsfragement wordt na het notuleren verwijderd.

* *Toestemming ontvangen*

R: Ik heb begrepen dat je dit doet voor het schrijven van de scriptie, over dit onderwerp; de Etruscanning.
I: Ja, het is een van mijn case studies.
R: Ken je mijn achtergrond?
I: Wel een beetje, maar dit was wel mijn eerste vraag of u eerst kon vertellen wat u met het project te maken had.

R: Ik ben universitair hoofddocent in Archeologie. Ik ben gespecialiseerd in pre-romeinse archeologie, waaronder dus de Etrusken. Ik werk al 30 jaar aan de Uva bij de afdeling. Het was eerst Klassieke Archeologie, maar het is inmiddels is het Amsterdam Centre for Ancient Studies and Archeology, ACASA heet dat. Ik ben sinds drie jaar directeur van de master en researchmaster. Ik heb heel veel gepubliceerd over met name tempels en dakversieringen uit de Etruskische en pre-romeinse tijd en ik ben toen Wim Hupperetz directeur werd van het AP museum, toen heeft hij mij benaderd om te helpen, omdat hij per se dat zijn eerste tentoontelling zou gaan over Etrusken, dus heeft hij mij gevraagd of ik mee wou helpen. Dat heb ik gedaan en dit was een samenwerking met het RMO Leiden. Het begon 2014, en 2015 ging het open?

I: Het project was in 2011.
R: 2011. Dan ben ik de jaren alweer kwijt. Maar in welk jaar was dan de tentoonstelling?

I: De tentoonstelling was in 2011/2012 en het liep door tot in 2013.
R: Dat is wel al lang geleden. Maar goed, dit was een project waaraan ik heb meegewerkt. Ik heb alle bruiklenen geregeld, dus een selectie gemaakt van alle bruiklenen en ik wist dat Wim zeer geïnteresseerd was in 3D reconstructies. Maar daar was ik ook mee bezig sinds 2000. Ik ben ook directeur van het 4D Research Lab. Heb je dat opgezocht?

I: Ja, en ik heb een keer met Tijm Lanjouw gesproken.
R: Dat is een ongelofelijk mooi project. De faculteit gaat ons lab ook integreren in het grote onderzoeksgebouw wat eraan komt in 2022/2023. En wij werken met de faculteit, met allemaal onderzoekers en daar maken wij 3D modellen voor, en scans en allerlei digitale dingen, dus helemaal niet alleen archeologie. We hebben 3 drones. We werken bij archeologische opgravingen, maar ook bij veel erfgoedprojecten en we werken samen met musea. We hebben nu ook een project bij het Allard Pierson lopen, voor studenten, het Blended Learning project. Dus dat 3D heeft er bij mij altijd ingezeten en Wim die heeft toen te kennen gegeven dat hij dit heel graag wilde ondernemen en toen heeft hij met [..] en met een paar belangrijke prominente figuren uit de 3D modeleer wereld heeft hij het project gestart. Ik was niet direct betrokken bij Etruscanning. Maar er is absoluut een link. Ik heb onder andere ervoor gezorgd dat een van de belangrijke terracotta beelden uit Veii is gescand en in 3D geprint, die staat boven. Ik weet niet of je die kent? Latoma. Het is een van de beelden die op het dak stonden van de tempel in Veii. Heel belangrijk voor dat beeld was dat we in een particuliere collectie die later naar het British Museum is gegaan, het missende kopje van het jongetje wat op haar schouder staat, dat hebben we toen te leen gekregen voor die tentoonstelling. Het kopje in het echt en het beeld in print ernaast, heel bijzonder, en dat heb ik ook gedaan, want dat is mijn specialisatie. Terracotta beelden op het dak, hier ging mijn proefschrift over. Is dat genoeg informatie? Ik was dus helemaal fout over het jaartal.

I: Dat maakt niet uit. Het is ook al wel een tijdje geleden inderdaad, maar mijn andere case study is wat recenter. Ik was benieuwd naar of u het eens was met de keuze van het digitale reconstructie middel welke werd gebruikt in de tentoonstelling? En wat uw visie daarop was.
R: Het was 2011. Dat betekent dat er heel erg veel technische vernieuwingen zijn geweest sindsdien. Natuurlijk was ik het ermee eens. Het was een van de belangrijkste graven die er zijn, het zogenaamde prinsengraf, al ligt er eigenlijk een prinses in. Hier is een hele serie van gevonden in Italië, uit die specifiek periode, de orientaliserende periode, de rijkste periode uit de Etruskische samenleving en voor het aller eerst, Maurizio Sannibale is de conservator van het Vaticaans Museum en de Etruskische collectie, deze collectie is nooit het Vaticaans Museum uit geweest. We hebben het voor elkaar gekregen om een groot aantal voorwerpen uit het Regolini-Galassi graf in die tentoonstelling te krijgen. Dat was fantastisch. We zijn toen naar het museum gegaan, Wim en ik en Tanja, en we zijn naar de 3 musea gegaan en we mochten uitkiezen: ik wil dit, ik wil dit.. echt geweldig. Die voorwerpen van het Regolini-Galassi graf, dat het voor het eerst het museum uitkwam, Italië uitkwam was zeer bijzonder. Het was vrijwel direct de bedoeling om van dat graf, dat ik wel ken uit mijn studententijd tijdens de excursie, dat kon je bezoeken al is het wel leeg, maar dat was een belangrijk project binnen de tentoonstelling om een grafkamer te reconstrueren om daar doorheen te lopen. En dat hebben ze gedaan met de scan.

I: Want op dat moment was dat de manier waarop dat gedaan kon worden met de digitale technieken die er toen waren?
R: Ja, maar ik moet wel eerlijk toegeven dat ik wat teleurgesteld was in de kwaliteit toendertijd en er was ook een soort systeem dat je naar binnen kon lopen en naar bepaalde plekken en dat je kon aanwijzen. De gescande voorwerpen, die kwamen in de reconstructie terecht om het echt te beleven. Nu zouden we, mijn lab zou dit niet goedkeuren. We hebben zulke goede apparatuur nu, dat zou er heel anders uitzien. En nu werken we ook heel veel voor tentoonstellingen, we maken apps en applications op tablets dat je door die reconstructies echt heel kan lopen, met brillen. En dat was toendertijd nog niet zo.

I: Het moet natuurlijk wel in zijn tijd geplaats worden.
R: Wat wel meteen duidelijk was dat bepaalde ontdekkingen werden gedaan doordat de voorwerpen werden gescant en dat bepaalde dingen die je met het blote oog niet zag en dat je die door de scan wel kon zien, inscripties of breuken.

I: Ja mijn volgende vraag was dus wat de toevoegende waarde van de applicatie was voor het verhaal? U zegt dus eigenlijk al, de wetenschappelijke waarde stond wel hoog voor u.
R: Naja, ik ben al sinds 2000 bezig met dat concept, met 3D modellen, het bouwen van 3D modellen, of dit nu met scans gaat of met fotogrammetrie of met Studio 4D Max, 3D Max, dat zijn allemaal andere programma's, zo kan je zelf een model bouwen in je computer. Maar je kan het scannen, scannen wat er over is. Bij de scans van het Regolini-Galassi graf kunnen wij een model maken wat je vervolgens helemaal aankleed en de voorwerpen erin terugplaatsen. Dat kan. Over de wetenschappelijk waarde, dat is heel simpel: het proces van het maken, van het modeleren schept gelegenheid om vragen te stellen. Vragen die je anders nooit stelt. Je gaat je afvragen, waar is het precies gevonden? Waar lag het precies en hoe lag het? Je gaat samenwerken met onderzoekers, die gaan nieuwe voorstellen doen, die gaan research doen. Maar het research wordt eigenlijk versleuteld in het

model gezet. En de modeleur die zit achter zijn computer en die vraagt een hele simpele vraag. Ik gebuik altijd als voorbeeld, ik heb toen in 2000 een tempel gemodeleerd samen met iemand van stichting Academisch Rekencentrum Amsterdam (SARA), dat bestaat nu niet meer. Samen met een ingenieur hebben we voor de cave een tempel nagebouwd, omdat ik een paar wetenschappelijk vragen had, waar ik niet uitkwam. Als ik het echt zou zien, dan zou ik antwoord krijgen. Dat hebben we dus gedaan. De tempel is nagebouwd en toen stelde hij bijvoorbeeld de vraag: Wat voor kleur waren de dakpannen? Maar ik zat al 20 jaar met die terracottas en dakpannen, maar daar had ik nooit over nagedacht. Dus dat was gewoon een hele simpele vraag. Ik weet het inderdaad niet, maar ik ga meteen terug naar Rome waar het in het magezijn ligt en ik ga dat bestuderen en toen bleek dat van die tempel dat die dakpannen zwart waren. Want er zaten restjes zwarte verf op. Maar daar had ik dus nooit bij stil gestaan. Maar nu gaan we veel verder. Ik publiceer nu ook artikelen over het modelleren van bijvoorbeeld een tempel. Dat is onderdeel van in de Oxford University Press en het wordt in een bundel gepubliceerd en er komt nu ook iets uit in de Amstedam University Press over reconstruction re-enactment replication, dat is een networkgroep waarbij allemaal onderzoekers bij elkaar gaan zitten die alleen maar bezig zijn met het nabouwen van dingen uit het verleden. Niet alleen archeologen, maar ook bijvoorbeeld resauratie, conservering reseauratie, schilderijen conserveren, het nabouwen van medische instrumenten om ze te testen uit de oudheid, de historische oudheid en meer van dat soort dingen. En re-enactment, het naspelen van situaties uit het verleden. Het zijn bijvoorbeeld mensen die spelen een indianenstam na in Duitsland en daar werken antropologen aan mee om te bestuderen wat voor conclusies ze eruit kunnen trekken. Dat is een groep onderzoekers en daar ben ik onderdeel van. Dus archeologie is een van de vijf disciplines. Wij zijn natuurlijk al, sinds het opgraven maken we al reconstructies.

I: De samenkomst van meerdere mensen bij elkaar brengt toch weer nieuwe inzichten.
R: Oh, maar dit is fantastisch en ik heb ook echt genoten van de lezingen. Maargoed, die zijn dus allemaal met hetzelfde concept bezig. Inmiddels is het uitgegroeid tot iets behoorlijk belangrijk, omdat het echt een onderzoeksmethode is die niet altijd wordt gebruikt. Het komt steeds vaker en steeds meer en dat komt dus door het reconstrueren als begrip. Maar het Regolini-Galassi graf was geweldig. Ik vond het inderdaad kwalitatief minder goed, maar het was toen een van de eerste.

I: Want wat vond u uiteindelijk de toevoegende waarde van de applicatie voor de tentoonstelling?
R: Ik vond het echt heel erg belangrijk voor het publiek. Een tentoonstelling is natuurlijk dat het publiek niet met een plattegrondje en die voorwerpen zich moet voorstellen hoe zo'n graf eruit zag, maar dat kan je nu zien. En ze kunnen erin lopen. Dat ze als het ware in de voetsporen van de archeoloog treden, die zo'n graf opent. Je weet Regolini en Galassi waren twee mannen. Maar die hebben dat graf gevonden en die troffen dat aan en het publiek vind dat enorm aantrekkelijk om dat mee te beleven als het ware.

I: Ja, want toen had het nog een beetje een Wauw-effect.
R: Dat hebben we nu nog steeds wel. Nu gaan we steeds verder. We ontwikkelen allerlei apps. Voor bijvoorbeeld Westerbork hebben we nu een app voor ontwikkeld in het lab, een project van Rob van der Laarse, hij doet heritage and memory studies eigenlijk. Hij werkt in een groot Europees verband aan een project dat heet Camp Scapes. Dat is dus opgraving reconstructie van vernietigingskampen. Westerbork is een van de kampen, en daar zijn wij als 4D lab bij betrokken. Het commandantenhuis, dat is gescannt en daar hebben we iets voor ontwikkeld waardoor je erin kan rondlopen, je mag er in het echt niet in, en dan kan je allerlei verhalen als publiek tegenkomen wanneer je door het huis loopt. Dat is dus het idee. Dat je veel meer informatie kan geven aan het publiek zonder dat je er letterlijk in hoeft te komen. Je hebt wel heel veel musea, in Frankrijk en Duitsland, dat gewijdt is aan WO1 1914-1918 en daar zijn de loopgraven letterlijk nagebouwd. Dus dan loop je als publiek letterlijk door de loopgraven in het museum.

I: Want wat vind u dat de uiteindelijke rol moet zijn van digitale reconstructie technieken in archeologische musea?
R: Naja, het kan nooit genoeg zijn. Je kan niet alles natuurlijk. Je hebt een museum vol met voorwerpen, maar ik denk dat je steeds vaker voorkomt dat mensen tablets gebruiken, computers en hardware en met touchscreens dingen kan bekijken. Het is vrij kostbaar nog.

I: Ja, er zijn wel dingen die worden tegen worden gesproken zoals dat men niet meer de echte object zien bijvoorbeeld. Of dat er heel veel technische dingen zijn waar men overheen moet komen en het kost inderdaad allemaal wel veel. Hoe zit u dit?
R: Een verhaal vertellen bij een object, zo is het altijd gegaan. Een bordje. Eerst was het bordje in het Italiaans, toen kwam er ook een bordje in het Engels. Maar dat zegt niks. Het zegt niet genoeg. Het publiek moet het verhaal erom heen krijgen. Je kan wel lappen tekst gaan schrijven, maar dat werkt ook niet. Waar musa dus steeds meer, steeds sneller naar overstappen is dat ze geproken verhalen vertellen en dat het publiek kan kiezen. Dus nu zie je al die mensen lopen met zo'n verhaal. Dan staan ze bij een schilderij en dan met een bandje wordt dan het verhaal verteld bij het schilderij. Bij archeologische musea kan dat ook, maar dat kan je natuurlijk ook veel meer bieden: de omgeving en de verhalen over hoe werd het gebruikt, waar was het geplaatst, hoe zag zo'n tempel eruit? Waarom tempels? Ik ben vanaf mijn 25 al daarmee bezig. Je heb funderingen en je heb het dak en dat is vaak ingestord. Alles wat ertussen zat was hout en dat is er niet meer. En ik moest dus reconstrueren. En daar ben ik gelijk mee aan de gang gegaan en begrijpen hoe zo'n dak in elkaar zit. En dan vervolgens uit zo'n dak allerlei antwoorden krijgen op hoe de houtconstructie in elkaar zat die verdwenen is. Je kan echt heel ver gaan. En de digitale hulpmiddelen zijn daarin erg belangrijk. Die maken het natuurlijk makkelijker.

I: En wat als bepaalde antwoorden niet kunnen worden beantwoord, omdat we het gewoon niet weten?
R: Dat is iets waarbij we in het 4D Lab heel erg veel mee bezig zijn. Onder andere ook de annotatie van modellen. Dus dat je er als het ware een notenapparaat eraan hangt. Dat als je een model ziet, dat je erop kan klikken en dat je achter het model van alle argumenten kan vinden, waarom er gekozen is voor de kleur zwart van de dakpannen, maar als je dingen niet weet, dat je dus verschillende soorten modellen aanleverd, met een model waar je dingen die je zeker weet laat zien en de rest leeg laat.

Maar dat ziet er vaak niet uit. Je moet dan verschillende fases hebben: wat we niet weten, wat we ongeveer weten, wat we zeker weten. Al die fases kan je dus in een digitaal model laten zien door bijvoorbeeld aan en uit te klikken. En dan de argumenten erbij die je eronder leest of in ballonnen eraan plakt. Met zo'n app kun je allerlei verhalen in zo'n model zetten.

I: Vaak, als ik digitale applicaties zie, dan vind ik het wel lastig om eruit te halen wat feiten zijn en wat interpretatie en inprovisatie is.
R: Dat is het grote probleem waar wij als 4D Lab mee geconfronteerd waren, helemaal aan het begin. Dat iedereen, ook al de archeologen zeiden: ach, die modellen, dat is allemaal fantasie. En dat wij voor het eerst, en dit is ook Europees en wereldwijd, zijn we iets aan het ontwikkelen waardoor dat dus makkelijker te behappen is. Dat je veel makkelijker informatie kan vinden in het model wat gebaseerd is op onderzoek en wat niet. Dus we distantiëren ons. Ik ben nog altijd overtuigd van dat mooie 3D modellen een museale opstelling enorm verrijken. Boven zie je ook, dat heeft Nico Kriek gemaakt, die werkt bij mij in het lab, visualisaties op basis van een 3D model, maar daar zie je dus niet aan wat echt is en wat niet echt is, waar en niet waar is. Maar we zijn 3D modellen steeds meer wetenschappelijk aan het beschouwen en daar zijn we dus al wel heel ver in om het uit de wereld te helpen dat 3D modellen gebaseerd zijn op fantasie. Maar dat er dus grondig onderzoek aan te slag ligt. En het gaat allemaal heel snel. Alle ontwikkelingen met scanners en fotogrammetrie en drones en drone fotografie, camera's, die ontwikkeling gaat razend snel. Er komen iedere keer betere apparaten. We zijn nu bijvoorbeeld bezig met een grote aanvraag, voor een europees project doen we mee met iemand uit Utrecht die Joodse catacombes wil scannen. En dan moet je alle catacomben in en alles scannen. De Joodse resten mag je niet aanraken vanwege geloof. Dus die scannen we zonder het aan te raken en die kunnen dan worden gereconstrueerd en onderzoek naar gedaan worden, met die scannen.

I: Als u er zo op terugkijkt, op het project, wat had er denkt u beter gekunt afgezien van de kwaliteit?
R: Ik denk dat we met de kennis van nu, dat we zo'n model zouden maken en dat we alle informatie erin zouden hangen. En dan met apps, en .. je kan er een heel verhaal in verwerken, en argumenten. De tombe is wat hij is, daar is niets aan gefantaseerd. Dat is een feitelijke ruimte. Maar de ligging van de objecten.. fantastisch natuurlijk dat Mauritzio Sannibale heeft gereconstrueerd. Die gouden fibulae, die blijkt helemaal niet op haar borst te hebben gelegen, maar op het gezicht. Als een masker, met een kroon. Daar heeft hij in de catalagus wel over gepubliceerd. Dus dan zou je het helemaal kunnen reconstrueren zoals Mauritzio denkt dat het is geweest.

I: Als nog een soort van laag over de eigenlijke applicatie.
R: Ja, en je kan het nog terug reconstrueren in de tijd. Je kan het graf reconstrueren zoals het is geweest toen het werd ingericht, met de werkelijke doden erin en met alle voorwerpen zoals ze oorspronkelijk bedoeld zijn. Het graf is in elkaar gestort en overhoop gehaald. Hij was niet bestolen. De archeologen hebben verslag geleverd, maar het lag helemaal door elkaar. Maar of het verstoord is geweest door instorting of iets anders, dat weet ik niet.

R: 4D reconstructie is trouwens de 4e dimensie: die staat voor tijd, bij ons. Dus we reconstrueren dus eigenlijk ook het tijdselement, de transformatie processen. Laten we even uitgaan van de tempel. Je scant de funderingen en dan volg je iedere bouwfase in het model. Je gaat terug in de tijd, je begint bij 550 voor christus tot nu of totdat de funderingen zijn gevonden, 1896, en die transformatie processen die leg je vast en daarom is het 4D. En ik denk dat de meerwaarde hiervan enorm is. Grote NWO aanvragen gaan niet meer zonder 3D reconstructies. Ze worden nu overal ingeschreven. Het is gewoon een fantastische manier van conserveren. Archeologie is, dat is het eerst wat geleerd wordt aan de studenten, archaeology is destruction, DE-struction. Dus je graaft het op en het is kapot. Je kan het eigenlijk bijna niet bewaren. Voorwerpen kan je bewaren, maar dat wat je opgraaft kan je niet bewaren tenzij je er een archeologisch park van maakt. Maar dat gaat ook kapot.

-- part skipped --

I: Denkt u dat musea soms doorslaan in het willen incorporeren van digitale technieken in een tentoonstelling, omdat het verwacht wordt?
R: Mensen verwachten dit wel. Voor alleen een tekening, dan komen ze niet. Nee, het is een onderdeel. We maken nu een tentoonstellig, waarbij we samenwerken. Het heet Waterloo plein, biografie van een buurt. Het gaat over een jodenbuurt en wij ook betrokken bij Vlooienberg. Vlooienbuurt ligt onder de Stopera. Het is opgegraven in 1980 en er zijn daaronder beerputten gevonden, het was een joodse wijk. Maar die is dus afgebroken in 1980 en de Stopera is erbovenop gezet. Wij zijn betrokken bij dat project, wij reconstrueren die hele wijk in 3D. Dat is voor een deel research. We werken samen met PhD's die aan Vlooiberg project werken, maar wat we ook doen is, we maken hele mooie visualisaties voor de tentoonstelling. En dat is dus ook een 3D model. Wat mensen kunnen zien, en wat ze kunnen downloaden op hun telefoon en dat is een heel belangrijk onderdeel van de tentoonstelling.

I: Maar u denkt dus niet dat door alle nieuwe innovaties, dat we onszelf verliezen?
R: Je moet het nooit overdrijven natuurlijk. Wat er in de tentoonstelling te zien zal zijn, zijn inhoudelijke beerputten, prachtige vaatwerk, botmateriaal, ook nog gewoon, gister haddden we een vergadering met het museum, gewoon een maquette laten ze zien. 2 3D modellen van de Synagoge en ze laten de ontwikkeling van Vlooienburg zien vanaf 1620 tot 1980. Dus het publiek kan feitelijk zien wat er is gebeurd in hun wijk. Er zijn verhalen bij, mensen hebben er gewoond, het is een heel breed pallet. Ik zeg alleen maar, 3D visualisaties en 3D digitale middelen, die zorgen alleen maar voor meer informatie. Het is echt beter dan een tekstbordje.

I: Dit vind ik zelf ook wel. Daarom is het mijn onderwerp.
R: En doorslaan, iedereen kan doorslaan. Ik heb wel eens een tentoonstelling gezien waarbij alles virtueel is. Dat is overdreven.

I: Ik vind ook dat je er dan een beetje in doorslaat. Ik vind ook niet dat dat moet gebeuren, omdat authentieke objecten ook veelsprekend zijn.
R: Mensen willen ook echte dingen zien. Ze willen geïnformeerd worden, maar ze willen ook echte dingen zien. Het is een combinatie, het evenwicht, de dynamiek tussen de twee dat is belangrijk. En het verhaal. Het moderne verhaal, het contemporaine verhaal. Verhalen van mensen, van bewoners, van overlevende ..

- Interview Lucas Petit, received 1st of October, 2019.

Annotation: The interview is communicated via mail, because Petit was abroad during the period of this study. I, the interviewer, will be indicated as 'I' and Lucas, as the respondent, will be indicated as 'R'.

The interviewee: Lucas Petit is archaeologist specialised in the archeology of Jordan, Palestine, Benin, Burkina Faso, (grind)stones and excavation methods. He has excavated in Syria, Joran and Palestine and promoted with his research on the archaeology from Benin, West-Africa. He is currently the curator of the collection Ancient Near East at the Dutch National Museum of Antiquities in Leiden.

I: Wat is uw mening over waarom het nodig is om als archeologisch museum archeologisch materiaal en processen te reconstrueren?
R: In het algemeen zijn digitale en echte reconstructies om twee redenen nodig: 1) het beeldend maken van een bepaalde situatie of object, en 2) het vastleggen van erfgoed. Dit laatste aspect wordt vaak onderschat, maar sinds de Irak/Syrië oorlogen is het duidelijk geworden dat we niet alles kunnen bewaren. Veel erfgoed leidt bewust of onbewust schade in periodes van onrust. Wat we wel kunnen doen is het digitaal opnemen en reconstrueren van situaties en voorwerpen zodat we deze informatie ook later nog hebben, terwijl de originele situatie is verdwenen of verwoest. Het eerste aspect, het beeldend maken, is vooral bedoeld voor het publiek of als lesmateriaal. Door middel van een reconstructie beleef je een situatie in het verleden anders als bijv. d.m.v. een beschrijving. Door deze belevenis kan het, in het geval van een museum, het publiek makkelijker begrijpen hoe het vroeger is geweest. Het is belangrijk om te beseffen dat een archeologisch museum niet slechts voorwerpen tentoonstelt, maar probeert het verleden te tonen. Reconstructies van het verleden laten meer zien dan het voorwerp. Het is dus een extra informatiebron.

I: Hoe spelen digitale middelen in het algemeen hier een rol in?
R: Tegenwoordig zijn digitale middelen niet meer weg te denken in een museum. Hierbij kan je denken aan schermpjes binnen een tentoonstelling met interactieve mogelijkheden, maar ook filmpjes en geluidsfragmenten. Maar het blijven voor ons altijd toegevoegde zaken, die niet noodzakelijkerwijs nodig zijn om de tentoonstelling te begrijpen. Er zijn genoeg mensen die juist dit soort digitale middelen liever niet in een museum willen zien of gebruiken. Ook deze bezoekers moeten kunnen genieten. Andere mogelijkheden zijn het gebruik van een app op je telefoon, waarmee je extra informatie over bepaalde voorwerpen of vitrines kan oproepen. Digitale reconstructies kunnen vrij makkelijk aan het publiek worden getoond d.m.v. een telefoon of een schermpje. Tijdens de Nineveh tentoonstelling hebben we ook een VR/AR dag georganiseerd (*virtual reality* en *augmented reality*), waarbij bezoekers met een 3d bril door een paleis in Irak konden lopen, digitaal dan. Dit was voor veel mensen een bijzondere ervaring maar is, i.v.m. geld en tijd, lastig te organiseren in een museum.

I: Welke rol speelde digitale reconstructie middelen (de computer animaties op de schermen, de 3D geprinte bas-reliefs, de Lamassus en de gekleurde reconstructie van Room V van het zuidwestelijke paleis) binnen de tentoonstelling Nineveh? (alleen als puur middel om een boodschap over te brengen bijv. of ook als onderdeel van de inhoud van de tentoonstelling?)
R: De digitale reconstructies van Nineveh tijdens de bloeitijd was belangrijk om de bezoekers te laten zien hoe ontzettend groot en indrukwekkend de stad rond 700 v.Chr. was. Een voorwerp is leuk en wellicht mooi, maar de relatie met het verleden is moeilijk te bevatten. Een bijschrift met bijv. de tekst "afkomstig uit het paleis van Assurbanipal", zegt minder dan een 3d reconstructie van dat betreffende paleis. Zulke reconstructies zijn bedoeld om de bezoeker te informeren maar natuurlijk ook om ze te vermaken. Een fly-over is altijd indrukwekkend. Wat betreft de 3D geprinte reliëfs, daar zat natuurlijk een erfgoed-aspect in. Zoals je weet, waren deze reliëfs verwoest tijdens de oorlog. Toen we hoorden dat er goede foto's waren gemaakt, zijn we begonnen om te kijken of deze informatie genoeg is om ze te reconstrueren – digitaal weer op te bouwen. Uiteraard om dit verhaal te vertellen aan de bezoekers, maar ook om deze voorwerpen digitaal te behouden. Het toevoegen van kleur, had zowel een onderzoekstechnisch als een publieksgericht aspect. Er was erg weinig onderzoek gedaan naar het gebruik van kleur op de reliëfs. Het was dus wetenschappelijk zeer interessant om met goede technische middelen de kleur te reconstrueren. Voor het publiek zijn de meest originele ongekleurde reliëfs vaak een beetje 'saai'. Als je het publiek toont dat ze in het verleden waren ingekleurd, wordt er anders naar gekeken. Net als de 3d reliëfs waren de reconstructies van de lamassus ook bedoeld om het publiek te vermaken en om aandacht te vragen voor bedreigd erfgoed. Iedereen had wel het filmpje gezien waarop strijders met hamers de lamassus te lijf gingen in Mosul en door deze voorwerpen te reconstrueren toon je dat erfgoed niet alleen het object zelf is, maar ook de herinnering en de informatie. Zoals gepland zijn deze twee lamassus aan Irak gegeven en zullen ze binnenkort in Mosul feestelijk worden onthuld.

I: Waren de digitale reconstructie middelen van toegevoegde waarde voor het verhaal van de tentoonstelling? Welke wel/niet en waarom?
R: We hebben zeer gelet op de meerwaarde van de reconstructies. Het gaat niet alleen maar om vermaak. We willen juiste informatie doorgeven, en dat geldt natuurlijk ook voor digitale reconstructies. Het is erg moeilijk om vanuit een archeologische context een reconstructie te maken, zonder al te veel erbij te fantaseren. Hiervoor hebben we niet alleen met universiteiten

samengewerkt, maar ook met computer deskundigen en 3d specialisten. Hierdoor is de wetenschappelijke waarde van het eindresultaat gestegen en daarmee de toegevoegde waarde voor het publiek. Zoals eerder gemeld heeft elke reconstructie een doel gehad, soms meer gericht op het publiek en andere op erfgoedbehoud. Maar iedere reconstructie had zijn doel binnen het verhaal van de tentoonstelling en dat maakte het eindproduct als geheel erg sterk.

I: Wat waren de belangrijkste aspecten waarop gelet werd in het proces van het maken van de digitale reconstructies? Wat stond er meest voorop?
R: Het belangrijkste was dat het dicht bij het origineel of de originele situatie zou komen. Slechts bij één reconstructie (op het beginscherm) is er gekozen voor een visueel aantrekkelijke computer animatie en minder voor wetenschappelijke betrouwbaarheid. Door talrijke specialisten in te zetten, zijn de andere reconstructies op dit moment wetenschappelijk verantwoord, d.w.z. volgens de huidige maatstaaf zijn ze betrouwbaar.

I: Wat was de verdeling reproducties en authentieke objecten binnen de tentoonstelling?
R: We hadden 10 reproducties in de tentoonstelling en, ik weet het niet meer zo precies, rond 250 echte voorwerpen. Omdat er nogal wat grote reproducties waren, voelde dat wellicht wat anders, maar veruit het grootste deel was origineel. Nog nooit waren er zoveel originele voorwerpen uit Nineveh bij elkaar, wat de tentoonstelling heel bijzonder maakte. De reproducties waren noodzakelijk voor het verhaal, met name de erfgoedzaal met de reliëfs en de lamassus.

I: Als u nu terugkijkt op de tentoonstelling, had u dan andere keuzes willen maken qua digitale technieken? Zo ja, waarom?
R: Ik denk dat we het maximale gedaan hebben met betrekking tot de beschikbare middelen. Natuurlijk is met een oneindig budget veel meer te bedenken en kunnen reproducties nog iets beter (of met andere materialen) worden gemaakt. Verschillende bedrijven (bijv. canon) hebben meegeholpen om de reconstructies te produceren zonder hiervoor veel te verlangen. Echt veel andere mogelijkheden hadden we niet. We hebben een aantal keer met vast beeldmateriaal gewerkt (opgeblazen foto's) terwijl het waarschijnlijker mooier was geweest om ook hier digitale middelen en schermpjes in te zetten. Een tweede moeilijkheid is dat we moesten werken met beperkt origineel beeldmateriaal, dan wel met een vindplaats dat ver weg ligt en moeilijk bereikbaar door omstandigheden. Hierdoor ontbreken soms details die je anders mee had kunnen nemen.

- Interview Angus Mol, executed 27 September, 2019. (37:37)

Annotation: While writing out the interview, some colloquial language will be changed to written language to make the text more easy to read. I, the interviewer, will be indicated as 'I' and Angus, as the respondent, will be indicated as 'R'.

The interviewee: Angus Mol is assistant professor at the Leiden University Centre for Digital Humanities. He is specialised in the application of network science to material culture history and the question of how the past is created and experienced in video games. He is co-founder of VALUE and has worked as the Digital Strategy Coordinator for the Prince Claus Fund for Cultrue and Development.

I: Heeft u er iets op tegen dat dit interview wordt opgenomen? Het interview moet uiteindelijk worden uitgeschreven en een geluidsfragment van dit gesprek zou hier zeer bij helpen. Het geluidsfragement wordt na het notuleren verwijderd.

* Toestemming ontvangen

I: Mijn eerste vraag is wat u bijdrage was in dit proces [de tentoonstelling Nineveh]? U zat niet in het process, maar u heeft natuurlijk wel iets eraan bijgedragen.
R: In die tijd werkte ik voor het Prins Claus Fonds, ik weet niet of je het kent, maar dat is een NGO, je kent misschien wel het Prins Bernhard Fonds, dat is een cultuurfonds, dat is voor cultuur in Nederland. Het Prins Claus Fonds is eigenlijk voor de cultuur van de rest van de wereld, specifiek op wat we vroeger ontwikkelingslanden noemden. En een van de dingen die het Prins Claus Fonds doet is CER de Cultural Emergency Response, dat gaat over het redden van erfgoed. En in die hoedanigheid, met Nineveh, er was natuurlijk genoeg aan de hand toen Mosul bezet was door IS, waaronder natuurlijk allerlei erfgoed wat vernietigd is of gestolen is of dat met Nergal Gate, de reconstructie daarvan is opgeblazen. Alle gates die er staan zijn gereconstrueerd en een van de reconstructies was dus opgeblazen. Dat soort zaken, dat gebeurd aan de lopende band. En het was voor het PCF om dat gezicht te geven in de tentoonstelling, samen met UNESCO. Aan het einde ervan was er een hele zaal over erfgoed redden, waaronder heel veel digitale reconstructies, maar wij hadden niet veel met de digitale reconstructies te maken. Wij hadden juist onder andere toen gekozen, omdat er zoveel 'digitaal geweld' al was, 'high tech geweld', zoals satelliet fotografie tot en met die 3D print reconstructies. Wat wij toen hebben gekozen met UNESCO, ik weet niet of je het element nog herinnert. Het was een element waar je doorheen moest lopen met twee spiegels tegenover elkaar, waardoor je letterlijk door een stukje Mosul van nu heen liep, met achterop Nineveh. Bij de ingang van de erfgoedzaal, RMO noemde het de ergoedzaal, alsof de rest geen erfgoed was. Wij kozen dus toen voor een low-tech oplossing, iets was dus eigenlijk bedoeld was, ik weet de naam van de kunstenaar niet meer, maar de bedoeling was dus om op een low-tech manier een soort van virtual reality te creëren, waarbij je dus met die twee spiegels en op schaal dus daadwerkelijk leek alsof je dus door dat stukje Mosul doorliep. Dus bij de muren van Nineveh liep. Dat hebben we toen ontwikkeld. Of ik wil liever zeggen, gefinancierd vanuit het PCF, want daar zat ik toen bij en de kunstenaar heeft het ontwikkeld. Daarnaast heb ik toen voor het PCF en het RMO voor een stichting die ik heb opgezet met wat andere archeologen en historicus, VALUE, ik weet niet of je hier wel eens van gehoord hebt. Lang geleden stond dit voor Video Games and Archaeology Leiden University, maar dat is al lang niet meer. Eigenlijk betekent VALUE niets meer, het begon ook zo, de term. Onder andere om te laten zien de meerwaarde, de value, van bijvoorbeeld van video games in dit geval. Als VALUE

hadden wij daar drie dagen gestaan, op verschillende plekken in het RMO, drie weekenddagen en hebben we daar een Minecraft georganiseerd. Dus dat mensen in Minecraft stukken van Nineveh gingen nabouwen. We hebben een stuk van het paleis nagebouwd en we hebben ook een muur van Nineveh nagebouwd

I: Dat konden mensen zelf doen?
R: Ja, als wij zo'n evenement doen, met een groep archeologen, dan is er één die dag die de bouwmeester is, die gaat iets bouwen wat erop lijkt en heleboel mensen die schuiven aan, vaak kinderen. Soms hebben die geen zin hebben om de muur na te bouwen en die gaan dan lekker verderop een griekse tempel bijvoorbeeld of iets anders wat er niet per se bij past. Maar niettemin, we hebben een heel groot stuk van een muur, de Nergal Gate geloof ik, nagebouwd toen en dus een stuk van het paleis met de kamers enzo. Er stonden dus 3 computers, waar mensen op konden zitten. Zeker in het RMO was het flink druk. We hebbben dagen gehad dat er van geïnteresserden iets van 300 man langs kwam, en kinderen achter de computer dus, bijna altijd kinderen. Ik weet de officele aantallen niet meer uit mijn hoofd, maar makkelijk 100 / 110 man. Je bent meer de tijd bij aan het houden dan dat je over de inhoud even kan praten. Maar de bedoeling is dus juist om heel veel, allicht het je andere vragen hierop aansluiten, maar waarom we dat deden specifiek met Minecraft en natuurlijk het PCF en UNESCO analoog virtual reality element, heel veel van de reconstructies die er gedaan worden, die zijn zo ongelofelijk high-tech dat mensen eigenlijk niet begrijpen wat er gebeurd, wat er gebeurd is, dus eigenlijk ook niet helemaal goed begrijpen waarom het een reconstructie is; is het echt, is het nep? En ook niet heel goed de waarde kunnen schatten, onder andere de waarde in hoeveel tijd er uberhaupt in gaat zitten. Maar ook gewoon letterlijk de inhoudelijke waarde van zo'n stuk archeologie, dat digitaal gemaakt wordt.

I: Ze snappen de reconstructie niet zeg maar, de technologie?
R: Ja precies, de technologie ervan dus niet. Hoe zet je een tempel in elkaar, hoe doe je aan virtual heritage maken als je dat in cinnema voor iemand doet en andere ingewikkelde stukken software. Hoe bedoel je, je hebt iets gescannt en je hebt het uitgeprint hier, hoe werkt dit dan? Leuk, want dat is dus iets wat voor je wordt gedaan, je kan daardoor zien hoe het was, maar als je dus met Minecraft aan de gang gaat, dan laat je dus mensen zelf reconstrueren, want dat werkt op schaal. Die Minecraft blokken zijn 1 bij 1 meter digitaal, dus het wordt nooit zo gedetailleerd en rijk als je zou willen als archeoloog, maar mensen kunnen wel zelf aan de slag en dan snappen hoe je hoe groot zo'n muur dan eigenlijk daadwerkelijk als je 1 bij 1 bij 1 meter ..

I: Ja, dat je vragen stelt die je nooit stelt als je alleen kijkt.
R: Ja. En wat we daar ook specifiek deden, als we daar de tijd voor hadden, dat we aan mensen vroegen: joh, heb je wel eens in Minecraft gemaakt online of offline en dat iemand dat dan vervolgens kapot gemaakt had. Kijk, dat gebeurt ook heel vaak in Minecraft dat mensen dingen van elkaar kapot maken, omdat mensen nou eenmaal dat ook doen en dan er dingen opbouwen. Dat is een aanknopingspunt, het is iets van jezelf, iets wat je zelf gemaakt hebt en dan is dat opeens kapot en dat is niet leuk en dat is hetzelfde verhaal als je gaat houden bij een stuk werelderfgoed, wat van ons allemaal is. Dat is ook kapot gemaakt door iemand. Dus dat soort dingen dat proberen we dan op die manier spelenderwijs over te brengen. Waarom we dat specifiek leuk vonden om te doen, dus naast die andere digitale, ik noem het geweld, het is natuurlijk geen geweld, maar alle digitale reconstructies die daar staan, een hele boel high-tech wat er stonden.

I: Was u het eens met de keuze van de digitale reconstructie middelen die werden gebruikt in de tentoonstelling? Welke mij vooral waren opgevallen waren de computer animaties op de schermen, de 3D geprinte bas-reliefs, de Lamassus en de gekleurde reconstructie van Room V van het zuidwestelijke paleis).
R: Was ik het eens? Ik ben geen Assyroloog, ik weet niet genoeg inhoudelijk van dit klopt en dit klopt niet. Wat ik durf te wedden is dat degene die de reconstructies gemaakt hadden natuurlijk wel met een oog van inhoud naar hebben gekeken. Waar ik het niet zo mee eens was, was dat het voor het RMO echt zo'n erfgoedzaaltje was: nu gaan we even laten zien wat er allemaal gebeurd met erfgoed hier recent, en dat dit heel erg gekoppeld werd aan het high-tech. En dat is hetgene waar ik het niet eens mee zou zijn. Maar kijk, zou ik meer inhoudelijk kunnen kijken, dit is niet hoe het eruit heeft gezien. Als je dat zou willen weten, Aris Politopoulos, ik weet niet of je de naam kent, dat is een van de mensen van value, die doet zijn PhD over Nineveh, hij is Assyroloog. Die zou veel beter inhoudelijk kunnen zeggen: vind je het terecht. Ik denk dat het goed is om bepaalde dingen te laten zien. Als we bijvoorbeeld oude resten zien en alle kleur is er vanaf. Dan is het goed om te laten zien aan mensen: dit is een heel kleurrijk, heel mooi iets. Ik denk dat een van de dingen, waarom ik vind dat het goed is dat jij dit onderzoek doet, en ik denk ik z'n algemeen waarom er meer onderzoek naar gedaan moet worden, is dat we eigenlijk niet goed weten wat de high-tech middelen die we inzetten hiervoor nu eigenlijk doen. Voor het publiek: vinden ze het leuk, waarom vinden ze het niet leuk? Vinden ze het inhoudelijk interessant, vinden ze het niet? Daar weten we eigenlijk niet zoveel over en nog minder over wat het publiek er eigenlijk van vindt. Wat het uberhaüpt doet met je ervaring van erfgoed of van het verleden. De vraag is dus of het wel effectief is om te zeggen, we hebben hier nu 3D geprinte stukken tempel. Ik zeg niet dat het niet effectief is, niet werkt, maar er wordt heel veel geld gepropt in dat soort technologie. Heel veel van dit soort dingen zijn onder andere tot stand gekomen door The British Council, die heeft het Cultural Protection Fund opgericht ook, daar zat 90 / 80 miljoen in en daar zijn heel veel van dit soort reconstructies uit betaald en fly-overs en animaties. En het komt altijd heel erg uit een goed bedoeld perspectief: laten we honderd duizende foto's die gemaakt zijn door toeristen om Palmyra opnieuw via fotogrammetrie opnieuw terug te laten komen. Maar de vraag is dus eigenlijk, dat soort reconstructies gaan aan een paar vragen voorbij, namelijk: wat betekent het nou eigenlijk dat het erfgoed, wat betekent het voor ons, dat het erfgoed er niet meer is. Wat betekent het dat wij in een westers museum dit soort dingen naar ons toe gaan halen en in 3D gaan reconstrueren. Dit zijn hele fundamentele vragen. Ik zeg niet dat de factor niet goed is. Er zijn een heleboel fundamentele vragen die helemaal niet beantwoord worden, vaak door de mensen die het wel willen doen. Mensen die wel fly-overs willen maken en satelliet foto's, mensen die wel dus de 3D scan willen maken. Wat ik daar vooral zag was, kijken wat we kunnen, het kan kapot zijn, maar we kunnen het ook weer terugbrengen. En we kunnen het hier krijgen en het is veel meer wat we kunnen dan waarom doen we het, waarom is het belangrijk voor ons. Dat zijn de dingen die ik specifiek

zou zeggen dat bij, niet alleen bij Nineveh hoor, maar in z'n breedst, digitale reconstructie projecten problemen zie. Misschien niet problemen, maar fundamentele vraagstukken die overgeslagen worden.

I: Op een gegeven moment had je de Triumph of Palmyra en die is toen nagebouwd en in 3D geprint. Hij is in 3 westerse landen geweest en Amerika, maar het is Syrisch erfgoed. En hierin is heel erg de kritiek te herkennen die je net zegt, waarom doen wij dit eigenlijk en waarom gaat het niet daar heen?
R: Die triomfboog, onder andere waren ze toen bezig met UNESCO om die boog naar Nederland te krijgen, maar toen kwam aan de horizon dat het een project was dat qua publiek niet zo goed lag, maar het is typisch een voorbeeld van uitwas, het wordt maar gedaan omdat het kan zonder heel veel context eromheen. Maar eigenlijk leiden heel veel van dit soort projecten hieraan. Want waarom stonden die 3D geprinte dingen in het RMO, waarom specifiek? Eigenlijk hetzelfde verhaal. Natuurlijk ging het over Nineveh, natuurlijk ging het over erfgoed, maar waarom printen wij het in 3D. Waar zijn die dingen daarna naar toegegaan? Staan ze nog steeds in het RMO of zijn ze teruggegaan? Het zijn heel veel van die vragen die uberhaüpt, wat je bijvoorbeeld zag in het Cultural Protection Fund van het British Council, die heel veel andere reconstructies projecten heeft betaald. Wat er altijd ingebouwd was, was een soort Teach the Teachers of lokale training, zo van nu gaan we ook lokale mensen trainen om een Iphone te kunnen gebruiken om zelf een 3D model te kunnen maken. Dat was een soort van okey, dat wordt dan gedaan, maar vervolgens wil dat heel veel van de waarde, de financiële waarde, van zo'n beurs is opgegaan aan geld geven aan universiteiten in Engeland, aan musea, specifiek aan staff in musea die als consultanten daar naartoe gebracht werden. En het zijn allemaal van die typische voorbeelden over hoe wij erfgoed veel geld waard vinden, British Council 90 miljoen, we geven het gewoon aan de regio. Maar waar het qua expertise wel een hoeveel geld bij neerkomt, de overgrote som van het geld is uiteindelijk gewoon in Engeland uitbesteed. Hetzelfde geldt denk ik ook voor heel veel andere dingen die gedaan zijn. Voor het RMO en Nineveh. Ik weet het niet zeker hoor, maar volgensmij zijn het heel veel organisaties van buitenaf die misschien met lokale partners werken, maar de vraag is wat die lokale partners dan voor inbreng hadden en wat voor meerwaarde ze eruit kregen. Kregen ze een dagloon of werden ze inhoudelijk ook in artikelen gezet. Het is allemaal heel ondoorzichtig eigenlijk. En dat is eigenlijk dus ook op miniatuur aan de hand geweest in de Nineveh tentoonstelling. Is er wel goed over nagedacht wat voor macht en ook andere financiële dingen er aan de gang zijn. Ik weet het niet hé, ik kan alleen zeggen wat ik zelf gezien heb en ik weet niet zeker of er iets mis is gegaan, maar ik vraag me af of daarover nagedacht is.

I: Denkt u dat dit soort projecten genoeg nagedacht hebben over de duurzaamheid?
R: Dat is denk ik een hele goede vraag. Ze hebben de bas-reliefs geprint en wat is erna mee gebeurd? Waarschijnlijk, als ze niet al vernietigd zijn, dat is natuurlijk nog een hele ander vraagstuk, wat ze in het RMO van zo'n bas relief vinden: vinden ze het een artefact wat ze in het depot willen of denken ze: het is nu klaar. Misschien weet jij het, misschien kan je erachter komen wat ermee gebeurd is.

I: Ik heb er met Petit over gepraat en hij heeft ze nog liggen.
R: Ah, die heeft ze nog liggen. Je kan je dus afvragen, we hebben dat gemaakt, waarom hebben we er niet van tevoren over nagedacht om naast die ontwikkelingskosten voor die 3D dingen transport kosten maken zodat ze daar naar een museum kunnen, voor hoe lang dan ook. Hebben wij de 3D geprinte dingen echt nodig?

I: De lamassus zijn wel naar Syrië gegaan.
R: Ja, heel goed, dat soort dingen. Ik zeg dus niet dat mensen er niet over nadenken, maar er wordt vaak niet over nagedacht en heel vaak is het dus met reconstructies, die heel mooi in onze hoofdsteden staan. Eigenlijk is het een digitale vorm van dekoloniale verbanden die er altijd al waren, waardoor we artefacten hiernaartoe hebben gebracht. Dat doen we nu, maar dan zijn de artefacten dan digitaal. Ik zeg niet dat de factor slecht is, want als digitaal is, dan zijn er allerlei dingen die er niet mee mee spelen, zoals authenticiteit, moeten we authentiek zijn als het niet het echte object is dat we meenemen. Maar daar nog steeds kun je vragen stellen over cultureel eigendom, culturele eigenschappen. Ik doe studie naar games, ik ben niet bezig met reconstructies an sieg, maar wel binnen games. Daar zie je bijvoorbeeld dat er heel veel cultural appropriation plaatsvindt door gamestudio's die bijvoorbeeld artefacten van allerlei andere inheemse groepen in Amerika in hun games zetten, 3D scannen en in hun games zetten, en allerlei dingen ermee doen die de inheemse bevolking niet leuk vinden, maar er wordt uberhaüpt niet voor betaald. Het idee dat je gewoon een digitale kopie ergens van kan maken en dan in je museum kan neerzetten zonder bijvoorbeeld echt die afspraken te maken, ik denk dat we nu nog niet goed genoeg door hebben dat die digitale kopie, dat heeft ook een bepaalde waarde. Misschien niet dezelfde waarde als het authentieke stuk dat echt uit de grond gekomen is, wat er echt staat, maar er zitten zeker bepaalde culturele waarde aan die we nog steeds in onze eigen culturele context weten te zetten zonder dat we goed overleg hebben met gemeenschappen daar op z'n breedst. Dat de lamassus daar naartoe zijn gegaan, dat zijn hoopvolle dingen. Maar het is maar één object van al die andere dingen die daar stonden en je kan eigenlijk, hé het is toch digitaal, we kunnen ook zeggen, we hebben net een Nineveh tentoonstelling gehad, het is heel moeilijk om de echte objecten ernaar toe te brengen, maar dat erfgoedstukje wat we hebben gemaakt wat allemaal te kopiëren is, dat zouden we daar kunnen recreëren, voor een paar maanden of desnoods voor altijd. Zo wordt het teruggeven van en dan heb je al een heel ander soort type relatie en dan wordt het recipro[cal] in plaats van dat wij het hier nu ge3D scant hebben voor het werelderfgoed.

I: Welke middelen vond u van toegevoegde waarde voor het verhaal van de tentoonstelling?
R: Ik denk dat het zeker toegevoegde waarde was. De vraag is meer van welke waarde. Wat ik merkte, wat de discussie bij het 'erfgoed' zaaltje was, aan het eind. Het stond echt aan het eind nadat mensen alle echte dingen al hadden gezien, dan werd er even dit gedaan. Ik had het verhaal eerder met behulp van die dingen erdoorheen gemengd gedaan, dus niet aan het einde helemaal. De vraag is dus welk verhaal de mensen echt hebben meegenomen. Ze komen om wat te leren over de geschiedenis, maar ook om de echte objecten te zien. Ik vraag me af, misschien hebben ze de aantallen daar wel van, of mensen daar gelijk doorheen gelopen zijn. Ik vraag het me af, het is aan het einde van de tentoonstelling. Je bent al overladen met de echte

artefacten, mensen zijn vaak na een uur er wel klaar mee vaak. Als je het helemaal aan het eind zet, dan kan je je afvragen hoe je het als museum zo'n technologische ondersteuning evalueert.

I: Vind u dat de technische middelen meer geïntegreerd, minder het onderwerp moesten zijn van het zaaltje en dat het gewoon geïntegreerd moest zijn.
R: Ik denk dat als je digitale middelen moet gebruiken als ondersteuning van je verhaal in plaats van als verhaal opzich, dan wordt het veel sterker. Dan denk ik ook dat de beleving van dat soort dingen, waar het uiteindelijk om gaat, veel sterker kan worden. Want nu, het erfgoedzaaltje, dat had net zo goed het gadgetzaaltje kunnen noemen, waar alle high-tech dingen staan. Het kan allemaal, dit klinkt allemaal heel kritisch, maar uiteindelijk heeft het te maken met niet dat we dat soort dingen niet willen, maar we snappen nog steeds niet goed, als samenleving als zn breedstst, maar ook binnen de museologische wereld, hoe dat specifiek te gaan integreren, die twee dingen. Vaak is het gewoon voor iemand die het gaat organiseren, die is bezig met objecten, echte dingen, allerlei ethische legal dingen die ze uberhaüpt al moeten weten en dan komt er ook nog eens de technische dingen bij, de gadgets. Voor veel mensen die met objecten bezig zijn, is dat het andere ding, het ding waar het niet om gaat.

I: Hoe het tot mij overkwam was het dat dat gedeelte speciaal gewijd was aan wat we kunnen doen tegen de destructie en dan specifiek op de technieken, dus dan zou je zeggen dat de technieken opzich het onderwerp was van de ruimte met de gadgets
R: Dat was wel inderdaad de bedoeling, maar ik denk dat het verhaal niet over is gekomen op mensen. Daar moest je echt voor gaan lezen. Ik ben geen museoloog, ik doe hier geen specifiek onderzoek naar, maar mijn oog op de beleving is dat bijvoorbeeld als je met Minecraft aan de slag gaat, dan gaan mensen eerst op in de gadget: oh is het 3D geprint, oh wat fantastisch mooi. Het bordje wat ernaast staat met de tekst, dit is waarom het hier hangt. als het er al naast hangt, dat wordt vaak niet gelezen. Dat wordt gewoon simpel weg overgeslagen. Want, er is een virtuele reconstructie van Nineveh, oh wat gaaf, we doen de bril op. Wie maakt het eigenlijk uit waarom en hoe het werkt? Wie het gemaakt heeft en wat het voor meerwaarde heeft voor het verhaal? Je kan er ook voor kiezen om een verhaal over destructie te vertellen wat niet als focus heeft: dit zijn de high-tech oplossingen voor erfgoed. Nee, je had ook een verhaal kunnen vertellen, hierin hadden ze zelfreflectief kunnen zijn. Dit is wel gedaan, maar mondjesmaat. Maar RMO heeft op een bepaalde manier ook bijgedragen aan erfgoed destructie, hetzelfde als IS nu heeft gedaan. Er zijn gelukkig maar weinig archeologen in de 19e eeuw die dingen hebben opgeblazen, maar dit is wel gebeurd. Maar niettemin, het andere van IS van beticht is, is dat ze erfgoed verkochten en het hele RMO dat is erfgoed verkopen geweest, of het Louvre. Je zou ook een verhaal kunnen vertellen wat niet ging over high-tech oplossingen. Je zou ook een verhaal kunnen vertellen wat veel meer ging over de mensen daar en wat mensen daar van hun erfgoed hebben, hoe we de mensen daar kunnen helpen om misschien samen werelderfgoed te behouden en te creëren, maar het gaat natuurlijk ook over: Mosul is een uitbarsten groeiende stad en het is al eigenlijk heel bijzonder dat daar heel Nineveh stadscomplex nog ligt, waar niemand op woont. Je kan je ook afvragen hoe dat komt. Dat komt natuurlijk omdat Irak een hele erge militaire staat was, waardoor er uberhaüpt die mensen ervan af geschopt worden. Als je in andere delen van de wereld zit, ik werkte in Cariben en al die sites zijn overzet met scooters en dat soort dingen. Ook die verhalen heb je. We willen heel graag, vanuit een erfgoed perspectief, dat de digitale ons gaat helpen erfgoed te behouden. Het verhaal wat door al de organisaties verteld wordt. Maar uiteindelijk gaat het niet over digitale technologie, het gaat over de mensen daar en hier. Je kan allerlei prachtige reconstructies bouwen, maar als je vervolgens zelf niet zegt dat we duurzaam omgaan met de reconstructies, en over tien jaar is het format niet meer up to date, weet niemand meer hoe ze het moeten openen of zijn de bestanden kwijt.

I: Dus het was een soort van populistische trick?
R: Ik zou het niet populistisch willen noemen, maar ik zou zeggen, we laten onszelf vaak, zeker mensen die niet de dingen zelf maken of er heel veel kennis van hebben, laten zich vaak door de belofte van de technologie soort van afleiden. Dit is de oplossing he, okey jammer dat daar een stel extremisten zit die het opblazen, maar wij hebben het via fotogrammetrie hebben we het opnieuw kunnen printen of ge3D scannt wat er nog over was en het is hier nu en kijk eens haha. Zo van, wij kunnen dit als oplossing en ik denk werkelijk niet ondanks dat ik digital Humanities lesgeef, dat de oplossingen in de technologie zelf liggen, maar echt veel meer in de menselijke kant van erfgoed. Waarbij de technologie dus wel heel goed ondersteunend kan werken, maar niet als oplossing an sig. Ik denk niet dat het fout gegaan is, het is heel mooi dat ten eerste dat het ondersteunend is en dat het kan en dat we laten zien dat het allemaal niet een hopeloos het-is-nu-weg-verhaal is. Dat is één kant van het verhaal. De andere kant van het verhaal is dat er veel meer reflectie daarop had kunnen zijn en niet per se wat doet techniek voor ons, maar wat zijn hier daadwerkelijk de oplossingen, en als ik het me goed herinner was het maar een klein stukje, het menselijk stukje en de rest was heel gefocused op high-tech.

I: Mijn volgende vraag was: welke rol vind u dat digitale middelen moeten spelen in archeologische musea? Dit heeft u natuurlijk al een beetje verteld.
R: Ja precies, ondersteunend. Technologisch willen zijn, het zijn media, die moeten nooit de boodschap zijn. Tenzij het een museum is over technologie, dan is het heel anders.

I: Nee, maar soms zie je wel dat bij sommige projecten dat je om het zo maar te zeggen dood gegooid wordt met alle high-tech interessante dingen en dan denk je uiteindelijk: wat heb ik nu eigenlijk gezien?
R: Het is helemaal te begrijpen, want de mensen die die dingen maken die zijn vaak heel erg enthousiast over wat ze maken. Wat ze eigenlijk aan doen zijn is het maken van cultuur. Uit ervaring, als je iets 3D geprint hebt of je hebt iets ge3D scannt of je heb op een andere manier een virtuele reconstructie gemaakt, dan voelt dat als iets maken, het voelt als een stukje cultuur hebben neergezet. En dat wil je met mensen delen, je wilt het laten zien. Je wilt ervoor betaald worden, je wilt het vaker doen. Mensen die dit soort dingen doen die zijn vaak super gepassioneerd, hebben super veel kennis in huis waar de mensen waar ze mee samenwerken weinig over weten. Het is dus heel makkelijk om dus iets te gaan verkopen, je kan heel makkelijk dit soort projecten kwijt, als het maar een beetje technologie heeft.

I: Eerder deze week heb ik gepraat met Wim Hupperetz en die vertelde dat er een driehoek is van de meta data, de feitelijke data, en dan heb je de techneuten en de curatoren en dat deze drie niet goed verbonden zijn. Dat de techneuten niet goed de curatoren begrijpen en de curatoren totaal niet weten wat je kan met de technologie. En dat die relatie beter moet worden ontwikkeld.
R: Specialistische kennis, de meta data en de brug ertussen en dat soort verhalen, maar heel vaak met mensen die een bepaald specialisme hebben, die praten graag vanuit hun eigen specialisme. Dat is hetgene waar je het overzicht van hebt, waar je de meeste macht hebt om het zomaar te zeggen. Dus heel vaak, maakt niet uit of het bij een museum is of ergens anders, ik heb ook website ontwikkelingen gedaan, waarbij het hetzelfde is. Of hier binnen de universiteit. Mensen praten heel erg vanuit hun inhoud en als je dat gaat doen bij dit soort projecten, dan gaat de ene praten over de inhoud en de andere praat over de techniek. Je hoeft niet per se hoeft te begrijpen hoe het gebeurd. Als je simpelweg als je duft aan te geven: ik begrijp het niet hoe het werkt, maar ik heb wel deze vragen vanuit mijn specialisme, bijvoorbeeld waarom zouden we dit uberhaüpt doen? Wat vind jij ervan als technologisch specialist dat dit erfgoed eigenlijk uit Syrië komt en dat het bij ons in het museum staat? Je zult zien dat die specialist als die vragen ook niet zal weten en als je dan denkt, oh die weet het antwoord ook niet dan betekent het misschien als museum specialist dat jij het antwoord wel zou moeten weten, of in ieder geval dat je eerlijk moet zijn dat hier geen antwoorden over zijn op dit moment. Dat soort vragen wordt over en weer bijna nooit gesteld in dit soort projecten, omdat we heel tevreden zijn om te zeggen: ik doe de boodschap aan de bezoeker en ik zorg ervoor dat er goede objecten er staan en een goed verhaal er is. Okey, dan zorg ik ervoor dat de reconstructie helemaal overeen komt met het archeologische idee ervan en dat de software in orde is en dat het de goede kleur heeft en dat het vervolgens ook nog betaalbaar blijft en herbruikbaar. Maar naar elkaar toepraten is dan denk ik de oplossing. Want het is vaak een te grote vraag om te vragen aan mensen, net zoals ik, ertussen te zweven. Ik ben geen programmeur, ik zou geen software ontwikkeling kunnen doen, ik ben ook geen extreme specialist in al die dingen waarin ik wel over kan samenwerken met mensen in de Geestewetenschap. Maar je hebt niet altijd dat soort figuren binnen je project. Je hebt ook niet altijd de luxe om jezelf te trainen in wat is eingelijk fotogrammetrie of 3D scannen en printing, wat betekent het technologisch gezien, voordat je het in je museum neer kan zetten? Je kan ook simpel gezegd zeggen: Ik weet het niet, maar ik heb wel deze vragen erover, en dat zou al een hele goede eerste stap zijn voor mensen.

I: Wat had er anders gekunt in de tentoonstelling qua digitale reconstructie middelen?
R: Het dus niet aan het eind zetten, maar het integreren. Het publiek wat erin geïntresseerd is handvaten te geven om het te snappen hoe werkt het nu eigenlijk. Wat is hier nu eigenlijk technisch gezien gebeurd? Er zijn natuurlijk zat mensen die naar het museum komen om het zien van objecten, het horen en zien van geschiedenis. Er zijn ook mensen die daarnaast het heel erg leuk zouden vinden om te weten hoe het gedaan wordt, het 3D printen. Daar hoef je geen ruimte voor te maken in het museum, maar bijvoorbeeld een QR code of een link naar een website waar gewoon simpelweg meta data staat om het zomaar te zeggen, zo van: oh wacht zo het is het proces gegaan.

I: Dat je de lagen van de opbouw van een reconstructie kan zien.
R: Bijvoorbeeld ja, precies. En de beslissingen die genomen zijn om tot die reconstructie te komen. Dat is natuurlijk niet voor iedere museum bezoeker die naar het RMO gaat interessant, maar ik durf te wedden dat er zeker een groot stuk is van mensen die daardoor op die manier beter uit de voeten kunnen met de digitale technieken die er stonden.

I: Ik vind eigenlijk dat het wel de verantwoordelijkheid is van een museum, dat als je een digitale reconstructie hebt, dat je moet laten zien hoe dat is opgebouwd. De keuzes die gemaakt zijn, die kan je niet laten zien, omdat het vast staat op een gegeven moment. Ik vind wel dat als je zoiets hebt gemaakt, dan heb je keuzes gemaakt, een interpretatie en als je een mooi schermpje ziet, dan ben je alleen overdonderd over wat je ziet. Ik vind eigenlijk dat hetgeen wat wel feitelijk is en wat niet feitelijk is, dat dit wel overgebracht moet worden. Dat is wat ik vaak mis bij de digitale middelen.
R: Het wordt op een gegeven moment zo levensecht, dat is natuurlijk een ander verhaal, dat het levensecht wordt, dat het bijna zo is als authentiek, allemaal ingewikkelde filosofische discussies die je daarover kan hebben natuurlijk. Dit soort discussies worden nu wel meer gehouden. Hoe laten we het daar zien? Ze [RMO] heeft het gehad over: moeten we nu de 3D geprinte reliefs, moeten we die nu verven of niet? Moeten we ze in de originele 3D geprinte kleur laten, wit of grijs geloof ik, of als we gaan verven, dan lijkt het wel alsof het echt echt zo was en dat we dat zeker weten. Dat zijn natuurlijk allemaal vragen. En zoals je aangeeft, wat je heel mooi kan zien als je reconstructies doet in het echt waarbij je ander soort kleur baksteen kan gebruiken of een ander materiaal gebruiken. Het is heel moeilijk om dat te doen in een digitale reconstructie, want alles is daarbij een reconstructie. Misschien heb je daar wel over gehoord hoor, waarom ze bepaalde keuzes hebben gemaakt. Je hebt toch wel het Wauw-effect. Bij een 3D geprint model, de kleuren die zijn heel lelijk, roze en groen, heel syntetisch, dan wordt het synthetisch en dat is natuurlijk het tegenovergestelde van authentiek. En dat is wat je in je museum misschien niet wil, maar misschien ook weer wel. Ze hadden ook allerlei high-tech oplossingen kunnen maken om bijvoorbeeld met een app met augmented reality over de geschilderde dingen ging, zodat je bijvoorbeeld nog het lelijke materiaal onder had kunnen zien of hoe het uberhaüpt het er als eerste eruitzag. Of ze hadden ervoor kunnen kiezen om het leijke materiaal te behouden en met de app de originele kleuren erover heen te doen. Het zijn allemaal keuzes die je kan maken als je het geld hebt en een app kan ontwikkelen. Over dit vraagstuk, authenticiteit, wordt natuurlijk al wel langer over nagedacht. Het is een traditionele vraagstuk.

I: Musea zijn natuurlijk wel heel gericht op presentatie.
R: Ja, en dat is iets wat je in virtual heritage, zou je dat niet hebben. Mensen die echt voor onderzoeksdoeleinden erfgoed ontwikkelen, die zullen altijd heel goed aangeven in de reconstructie, wat er gereconstrueerd is en wat niet. Maar dat is niet naar het publiek toe, maar voor ons eigen research. Daar zijn we nog niet over uit met z'n allen, maar er wordt wel over nagedacht.

Questionnaires

Vragenlijst Nederlandse archeologische musea
Opgesteld door: Katelin Post
Beantwoord door Annelies Koster en Marenne Zandstra van Museum Het Valkhof

1. **Wat is uw mening over waarom het nodig is om als archeologisch museum archeologisch materiaal en processen te reconstrueren?** Wat als archeologisch overblijfsel aan ons is overgeleverd, is haast per definitie incompleet. Met reconstructies (zowel analoog als digitaal, al is er digitaal veel meer mogelijk) kunnen we deze overblijfselen van het verleden op een aansprekende manier aan het publiek presenteren.

2. **Gebruiken jullie in het algemeen digitale (reconstructie) technieken binnen het museum? Je kan hierbij denken aan computer animaties, reconstructies die aan de hand van GIS zijn gemaakt, VR, AR, 3D geprinte objecten (/reconstructies) etc. Waarom wel / niet?** In de vaste opstelling hebben we een aantal digitale middelen staan, die destijds ontworpen zijn voor specifieke tijdelijke tentoonstellingen. (T.w. reconstructie van het hoofdkwartier van de Romeinse legerplaats en de Romeinse markthal op de Hunerberg in Nijmegen-Oost; Google Maps voor de Romeinse limes). Het kostenplaatje staat soms in de weg. Daarnaast worden voor nieuwe tijdelijke tentoonstellingen steeds meer digitale middelen ingezet.

3. **Wat zijn de afwegingen in het ontwerpproces waarmee jullie beslissen dat de digitale technologie / middelen worden gebruikt, en wat is hun doel?** De afweging, of de toegevoegde waarde van dien aard is dat de kosten te verantwoorden zijn.

4. **Wat is de toegevoegde waarde van het gebruik van digitale technologie / middelen in een archeologisch museum volgens u?**Op een ruimtebesparende manier kunnen allerlei zaken inzichtelijk worden gemaakt, van monumentale architectuur tot ontwikkelingen door de tijd heen. Bovendien kan met digitale middelen het verleden beleefbaar worden gemaakt.

5. **Wat is de problematiek volgens u met het gebruik van digitale technologie / middelen?** De techniek gaat snel, waardoor een presentatie al snel verouderd kan lijken, vooral voor de huidige generatie. Daarnaast kunnen digitale middelen kwetsbaar zijn (vastlopen, stuk gaan etc.), en het evenwicht in de opstelling verstoren als bijvoorbeeld de aandacht van schoolklassen of groepen kinderen alleen maar naar die digitale middelen uitgaan.

6. **Is /was er een duidelijk verwachtigspatroon tussen jullie en de technische partners waarmee jullie samenwerken / hebben samengewerkt bij het ontwikkelen van digitale applicaties / digitale middelen een tentoonstelling? Zo ja, wat was dit verwachtingspatroon?** Bij een aantal virtuele reconstructies van Romeinse bouwwerken (gemaakt in 2004/5 en 2009) was in de eerste plaats de correctheid van de reconstructie van het gebouw het uitgangspunt van het museum

en de maker. Bij nader inzien had meer gekeken moeten worden naar de behoefte van het publiek (de films werden in het algemeen te lang en te traag gevonden en klinisch, omdat alleen de gebouwen te zien waren en niet de gebruikers/mensen die er in rond liepen). Er was wel goede samenwerking voor de inhoudelijke input, maar de maker had nog moeite met het inbrengen van figuren. Bij recenter gemaakte digitale applicaties, zoals de digitale Limeskaart, was de samenwerking met de makers uitstekend.

7. **Wordt er nagedacht over de duurzaamheid van technische middelen binnen het museum?** De digitale presentaties die in het verleden zijn gemaakt worden gearchiveerd als ze niet meer in het museum worden gebruikt, zodat altijd terug gekeken kan worden en evt. hergebruikt. Als het gaat om technische apparatuur voor de digitale middelen: dat zal in het kader van de duurzaamheid zeker gaan gebeuren bij de op handen zijnde verbouwing en herinrichting van het museum.

8. **Wordt het door het publiek verwacht dat archeologische musea digitale technieken / middelen gebruiken?** Het enthousiasme waarmee met name de interactieve digitale middelen worden benaderd maakt duidelijk dat het publiek het inmiddels wel verwacht.

9. **Wanneer wel gebruikt, zijn er binnen het museum evaluaties geweest over wat het publiek en het museum zelf vindt van de digitale technieken / middelen; hoe het tot nut en van waarde was? Zo ja, wat was het resultaat van deze onderzoeken?** Er zijn geen specifieke evaluaties gericht op specifiek dit thema geweest, wel binnen het kader van een tentoonstellingsevaluatie.

Vragenlijst Nederlandse archeologische musea
Opgesteld door: Katelin Post
Reactie Marjolein van den Dries- Archeologisch Museum Haarlem

1. **Wat is uw mening over waarom het nodig is om als archeologisch museum archeologisch materiaal en processen te reconstrueren?** Het is belangrijk om bij het vertellen van je verhaal aan het publiek dit op een zo beeldend mogelijke manier te doen: dit maakt het voor het publiek makkelijker en leuker en begrijpelijker. Een beeld zegt vaak meer dan heel veel woorden. Ik ben er dus groot voorstander van: reconstructies in welke vorm dan ook, in afbeelding of 3D. Omdat het dan dichter bij de bezoekers komt, realistischer wordt en soms ook zaken gewoon duidelijker: een hoop paalgaten in het zand / vlak zegt men niet zoveel, maar daar een reconstructie van de boerderij van maken wel. Het brengt zaken tot leven. En je kunt het ook nog als communicatie/ marketing in zetten. Zoals wij in het museum Cornelis, de middeleeuwse Haarlemmer hebben (een mensfiguur). Werkt goed bij bezoekers en in onze communicatie.

2. **Gebruiken jullie in het algemeen digitale (reconstructie) technieken binnen het museum?** Wij hebben een mensfiguur: Cornelis. Gemaakt a.h.v. analoge en digitale reconstructie technieken: 3D print van de schedel. Daarnaast hebben wij een film

Haarlem in Vogelvlucht met reconstructies erin. Dit is een gemeentelijke productie over de geschiedenis van Haarlem. Veel van deze digitale reconstructies zijn hoe mooi ooi, erg duur en valt daarom buten ons budget. Als het budget voorhanden zou zijn, dan zou ik zeker meer met digitale middelen doen en ook 3D replica's laten printen.

3. **Wat zijn de afwegingen in het ontwerpproces waarmee jullie beslissen dat de digitale technologie / middelen worden gebruikt, en wat is hun doel?** Het moet recht doen aan de archeologische wetenschappelijke uitgangspunten en bevindingen. Maar het mag een vertaalslag zijn, voor het publiek. Zolang je kunt verantwoorden waarom je bepaalde keuzes hebt gemaakt. Kosten wegen zeker mee. En het moet passen bij het verhaal dat je wilt vertellen.

4. **Wat is de toegevoegde waarde van het gebruik van digitale technologie / middelen in een archeologisch museum volgens u?** Het geeft meerwaarde voor bezoekers: middels bv. VR technologie kan je rondlopen in de middeleeuwen, je hoeft er geen complete zaal voor in te richten om bezoekers toch een historische sensatie te geven.

5. **Wat is de problematiek volgens u met het gebruik van digitale technologie / middelen?** Kostbaar, techniek is soms fragiel en onderhevig aan onderhoud, technische storingen en daarmee gemoeide kosten. Praktisch: ons museum draait vooral op vrijwilligers die je niet of zo min mogelijk met digitale zaken moet belasten, de kennis is niet in huis dus moet je inhuren.

6. **Is /was er een duidelijk verwachtingspatroon tussen jullie en de technische partners waarmee jullie samenwerken / hebben samengewerkt bij het ontwikkelen van digitale applicaties / digitale middelen een tentoonstelling? Zo ja, wat was dit verwachtingspatroon?** /

7. **Wordt er nagedacht over de duurzaamheid van technische middelen binnen het museum?** Niet specifiek, wanneer je iets ontwikkeld wil je dat voor een bepaalde termijn ontwikkelen. Afhankelijk van het product zal dit korter of langer zijn. Ik stel me voordat de technieken in bv VR sneller gaan dan bij de reconstructie van een skelet.

8. **Wordt het door het publiek verwacht dat archeologische musea digitale technieken / middelen gebruiken?** Ik denk dat het nog niet heel erg verwacht wordt maar dat dit wel de toekomst is. Mensen verwachten wel sneller iets van een touchscreen of audiotour. Hoewel wij echt een klein museum zijn.

9. **Wanneer wel gebruikt, zijn er binnen het museum evaluaties geweest over wat het publiek en het museum zelf vindt van de digitale technieken / middelen; hoe het tot nut en van waarde was? Zo ja, wat was het resultaat van deze onderzoeken?** Niet van toepassing: hier is door ons nog geen onderzoek naar gedaan.

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Figure 3.7: Reconstructed palace room with colour reconstruction. Musea.tv, “Nineveh in Rijksmuseum van Oudheden - Kwetsbaar Erfgoed en Technologische Ontwikkelingen,” streamed on November 15, 2017, YouTube video, 6:26, https://www.youtube.com/watch?v=gZBYP3H3RrY&t=101s.

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