

Documentation for Virtual Reconstructions. One Year R-A-M – Reconstruction-Argumentation-Method – A Report of First Experiences

MARC GRELLERT and MIEKE PFARR-HARFST, Technische Universität Darmstadt, Digital Design Unit, Germany
JOCHEN SCHMID, Vorderasiatisches Museum Berlin, Staatliche Museen zu Berlin – Preußischer Kulturbesitz, Germany

In November 2016 the documentation method for virtual reconstructions, “R-A-M”, (Reconstruction-Argumentation-Method), developed in Darmstadt, was introduced to the international community. This project was presented at the Euromed in Nicosia and at the CHNT in Vienna. In the meantime, it has been developed into an online tool in the status of a prototype (www.sciedoc.org) and has been used by various projects. Based on the fact that it was common that no documentation was made for virtual reconstructions, due in part because the client did not request this, lack of established standards and, as a rule, insufficient human and financial resources, the Digital Design Unit of the Technical University of Darmstadt developed a proposal for a minimal standard. This concept stemmed from the consideration that one needed to reduce the hindrances for documentation and instead choose a practical approach that is extremely user friendly and very easy to understand.

The paper reports about the actual status of the development, about the use as a communication tool (Klenow castle, medieval synagogue Cologne) as well as the experience gathered with the belated documentation of projects (Tell Halaf, scientific advice Vorderasiatisches Museum Berlin). Already now the use of the tool shows that the work procedure for a reconstruction was able to be systemized and in perspective also be standardized without bypassing individual work methods. The question is whether systematization can be so effectively developed that in the end through the use of such a tool as a communication platform a documentation of fundamental principles, processes and results of the reconstruction can be achieved that satisfy the requirements of a scientific publication. The goal is to come to an agreement with as many national and international parties as to how virtual reconstructions are to be documented in the future.

Key words:

Virtual reconstruction, documentation, standards, Ancient Near East.

CHNT Reference:

Marc Grellert et al. 2019. Documentation for Virtual Reconstructions. One Year R-A-M – Reconstruction-Argumentation-Method – A Report of First Experiences.

□

Author's address: Marc Grellert and Mieke Pfarr-Harfst, Digital Design Unit, Technische Universität Darmstadt, El-Lissitzky-Straße 1, 64287 Darmstadt, Germany; email: (grellert, pfarr)@dg.tu-darmstadt.de; Jochen Schmid, Vorderasiatisches Museum, Staatliche Museen zu Berlin – Preußischer Kulturbesitz, Geschwister-Scholl-Straße 6, 10117 Berlin; email: j.schmid@smb.spk-berlin.de

INTRODUCTION

Since almost 30 years virtual reconstructions have been made at the Digital Design Unit of the Technische Universität Darmstadt. For example, the Moscow Kremlin, the Temple of the Aztecs in Mexico, Imperial Tombs of China, the virtual reconstruction of destroyed German synagogues or the Cathedral of Florence. Over 100 projects were carried out in Darmstadt.

Looking back – from a scientific view – there was always a lack of documentation. On the one hand, the reasons are the relatively new discipline and the lack of agreements, standards and methods. On the other hand, normally clients did not provide extra money for a documentation. And they did not need the documentation. Already in 2010 Mieke Pfarr-Harfst developed an ideal way for a scientific documentation of virtual reconstructions [Pfarr 2010]. Besides good scientific practice, also the guarantee to have access to knowledge embedded in reconstructions should be realized [Grellert and Haas 2016]. Also other institutions were looking for documentation solutions and tried extensive maximal applications, often in combination with complex data bases and annotations to real time models [e.g. Kuroczyński et al. 2014; Brusckhe and Wacker 2015; Demetrescu and Fanini 2017]. Demetrescu and Fanini also refer to various projects in this field and one could find a large number of examples.

After carrying out our own approach mentioned above, it was relatively quickly clear that for our “normal” projects such an ideal solution would take too much time and thus too much money. Our hypothesis is that these maximum solutions with complex structures or / and annotated models will probably not reach the mass of the reconstructions although they are very attractive and maybe the technically best solutions. This does not mean that they could not reach them in the future. In order to do so probably current visualization software like 3ds Max, Maya or Cinema 4D must have by themselves possibilities to annotate and also be able to automatically export textured real time models without additional time. Maybe in the future BIM or game engine software will be more important and bring new possibilities.

Our assessment is, if reconstructions are not embedded in well financed research projects or are a part of large individual research work, because of failing resources, there will be huge obstacles to document the decisions in reconstruction projects. Because most reconstructions don't have this research context and without documentation more and more knowledge will be lost, it seems reasonable to look for a solution which fits the majority of the reconstruction projects and to keep obstacles as small as possible. That means for example: no need to learn another software or complex procedures, no need to include IT specialists, no need to transform models into other software, no need to change the familiar reconstruction software. At the same time, there is the wish to find a solution which could include all kinds of reconstructions: reconstructions 1:1, models or drawings of reconstructions.

Against this background a minimum standard was developed – “R-A-M”, (Reconstruction-Argumentation-Method). The idea for the new tool was introduced 2016 at the Euromed in Nicosia and at the CHNT in Vienna and challenges, circumstances and different concepts for documentation were discussed. [Pfarr-Harfst and Grellert 2016]. In the meantime an online tool which is used already by various projects has been developed. The tool has the status of a prototype (www.sciedoc.org). The paper will explain the starting point, the actual main functions of the webtool and will talk about the first experiences using some projects as an example. The focus here will be the reconstruction of the Aramaic Western Palace of Tell Halaf.

THE TOOL

The tool developed has three main parts. A first part, a text oriented one, describing the project, its background, technology and software used, people involved, etc. (Fig. 1). The second part – and this is the core – is a simple documentation of the reconstruction process of the decisions (Figs. 2-9). A third part contains the results of the reconstruction: renderings and films (Fig. 10).

In the second part – the documentation of the process of a reconstruction – the reconstructed building is divided into different areas. For example, areas could be the roof, the walls, the floor or the entrance facade (Figs. 2, 3). For each of these areas there might be one or more variants showing how the building could be reconstructed. Variants could be the angle of the roof or for a certain wall the kind or the number of windows; in the case of Tell Halaf for example different variants for the entrance facade. (Figs. 4, 5, 16). Each variant is represented by a rendering or a screenshot – RECONSTRUCTION (Fig. 6, left red frame), and another image that contains the source, such as a drawing of the features or even a scanned text – SOURCE (Fig. 6, right red frame).

These both will be linked to a written text – the ARGUMENTATION (Fig. 7). For all areas and respective variants there are these triads “Reconstruction – Argumentation – Source” (Fig. 8). Fig. 8 shows the front end, which will be visible if the documentation is online for the public.

This core can be done just with on one single page. Such a simple documentation is useable for every kind of architectural reconstruction, such as haptic models, reconstruction drawings or physically reconstructed buildings. The following scheme shows this core:

Project

Area 1 - Roof		
Variant 1 – Angle 30 °		Reconstruction – Argumentation – Source
Variant 2 – Angle 45 °		Reconstruction – Argumentation – Source
Area 2 - North wall		
Variant 1		Reconstruction – Argumentation – Source
Area 3 - South wall		
Variant 1 – Two windows		Reconstruction – Argumentation – Source
Variant 2 – Three windows		Reconstruction – Argumentation – Source
Variant ...		

Main features

The procedure to use the tool is very simple. There are three main steps. The first step is to fill in the data for the project description. Fig. 1 shows the backend filled with the data. The second step is the documentation of the decisions. Figs. 2 – 7, 9 show the backend. For the documentation one first defines the areas. This should be done in advance. The question is if there is an almost equal solution for types of buildings or will each project carry out its own solutions? After entering an area, one creates a variant and then adds to the variant the reconstruction images(s), the source(s), and a text which explains how one reached the reconstruction of a variant or area. The input of the decisions can be done just on the same single web form. The third main step is to add the results. The information for the different sections is as follows:

Project information

Here the main information about the project can be found: Project name; Runtime of the project; Institution, under whose umbrella the reconstruction was undertaken; Person/persons responsible; Scientific advice; Contracting body/co-operation partner(s); Sponsor; Hardware and software used; Geographic coordinates of the reconstructed building or urban environment; Project website; Name(s) of the contact(s) with email address and phone number; Further information about the institution: email address, phone number, website; Address and acronym of the institution, Short and longer description of the project; Construction period of the building reconstructed. (Fig. 1)

Area

The number of areas (1: n), the name of the area and an overview image (with caption) in which the area is mapped is displayed (Figs. 2,3).

Variants

Here the number of variants (1: n), the name of the variant, an assessment of the variants as ‘substantiated’, ‘probable’, ‘possible’ or ‘hypothetical’ and an indication whether or not the variant is part of the final presentation of the project is shown. If a certain variant was chosen, the respective triad Reconstruction – Argumentation – Source will be displayed. (Figs. 4,5)

Reconstruction

Here one can find the image of the reconstruction of the respective area / variant accompanied by a caption. Several images are possible (Fig. 6, left red frame).

Source

Also several sources could be added to the respective area / variant (Fig. 6, right red frame). The metadata for the sources are: Caption; Author; Date of origin; Archive; Signature; Copyright holder; Direct URL if available; Personal comment for further information; Type of source; Information where the source was published: title, year of publication, information about the editor, page, year.

Argumentation

In this field there is a simple free text input. The text describes how the related and displayed sources led to the reconstruction and what other considerations are important. (Fig. 7)

Results

As results images or films can be seen here.

Special features

All images in a project are assigned an individual number which can be referenced. It is possible to add an external comment, including an image to a certain area / variant (Fig. 9). For discussion with external parties, a temporary link can be created to show an ongoing project.

Scientific Documentation for Decisions
The Reconstruction Argumentation Method

Startseite Kontakt Marc Grellert DE

Tell Halaf

Bearbeiten

Projektbeschreibung Rekonstruktion Bereiche Ergebnis Offener Kommentar Projektverwaltung

Beschreibung

Virtuelle Rekonstruktion des aramäischen Westpalastes und des assyrischen Nordostpalast von Tell Halaf im heutigen Syrien.

Projektdetails

Webseite:
Gebäudetyp: Palast
Anlage: Guzana
Bauzeit: 1. Jahrtausend v. Chr.
Projektstatus: Abgeschlossen
Projektstart: 08.01.2013
Projektende: 01.05.2014

Ansprechpartner

Marc Grellert

Wissenschaftliche Beratung

Nadja Cholidis, Ulrike Dubiel, Lutz Martin, Jochen Schmid

Beschreibung

1899 entdeckte Max von Oppenheim am Tell Halaf, Syrien einen aramäischen Palast (den sogenannten Westpalast) mit monumentalen Skulpturen und Bildreliefs. Sie stammten aus dem frühen 1. Jt. v. Chr.
Nach erfolgreichen Verhandlungen mit den syrischen Antikenbehörden konnte Max von Oppenheim eine Fundteilung erwirken, die ihm etwa zwei Drittel der Grabungsfunde bescherte. In seinem privaten Tell Halaf-Museum in Berlin-Charlottenburg zeigte Oppenheim ab 1930 nicht nur die Originalskulpturen, sondern auch eine dreidimensionale Rekonstruktion der Eingangsfassade mit

Institution

TU Darmstadt
Straße : El-Lissitzky-Strasse
Postleitzahl: 64287
Stadt: Darmstadt
Telefon: 0049 6151 1622481
E-Mail: sekretariat@dg.tu-darmstadt.de
Webseite: http://www.dg.architektur.tu-darmstadt.de/dg/forschung_dg/digitale_rekonstruktionen/projekte.de.jsp

Bearbeitung

Jochen Schmid, Lutz Martin, Marc Grellert, Nadja Cholidis, Ulrike Dubiel.

Auftraggeber/Kooperationspartner

Bundeskunsthalle Bonn

Sponsor

Bankhaus Sal. Oppenheim

Hardware/Software

Maya

Zusatzinformation

Geokoordinaten

Langengrad: 0.000000°

Fig. 1. Project information Tell Halaf, screenshot www.sciedoc.org.

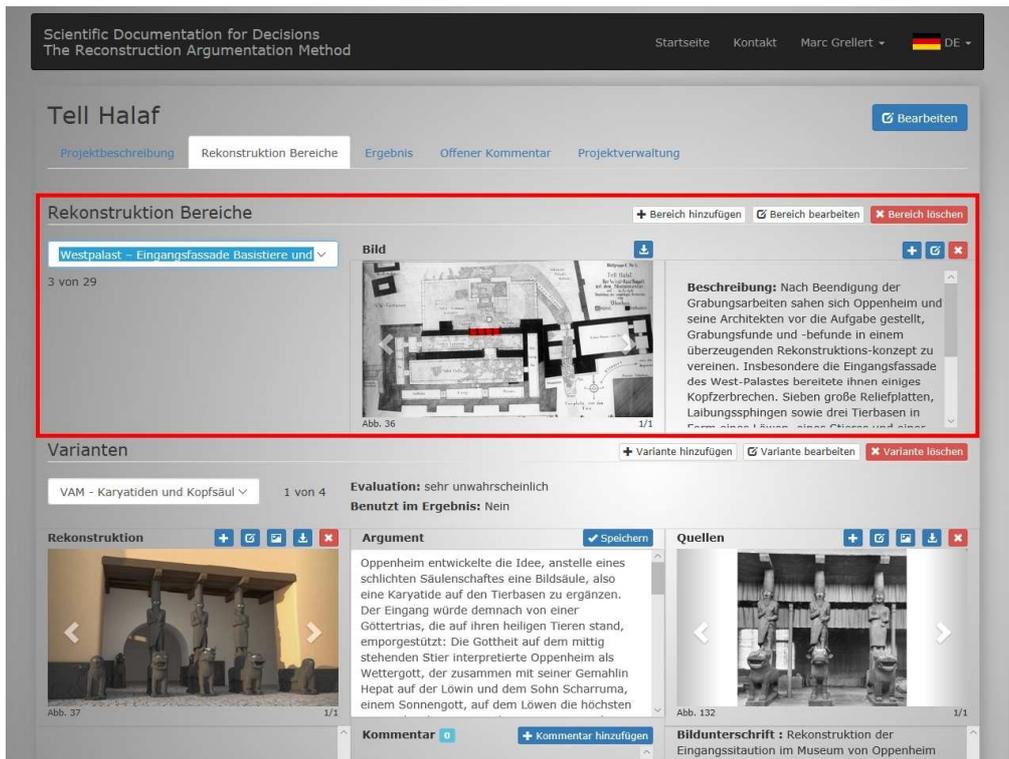


Fig. 2. Reconstruction area entrance facade, project Tell Halaf, screenshot www.sciedoc.org.

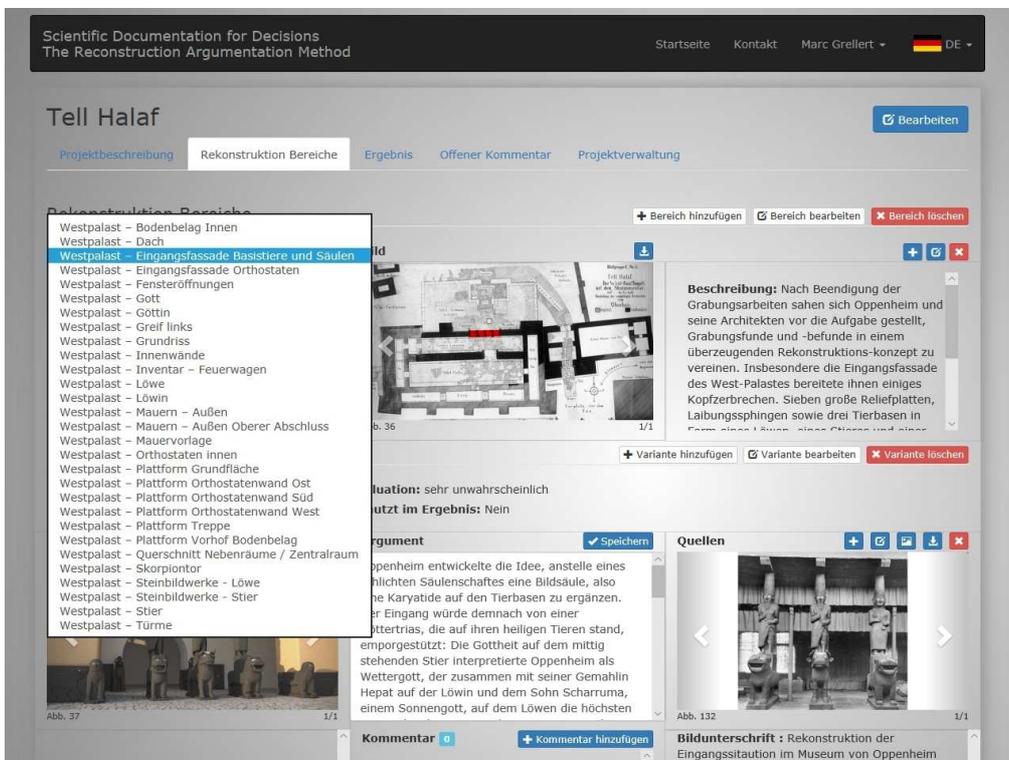


Fig. 3. Selection of areas, project Tell Halaf, screenshot www.sciedoc.org.

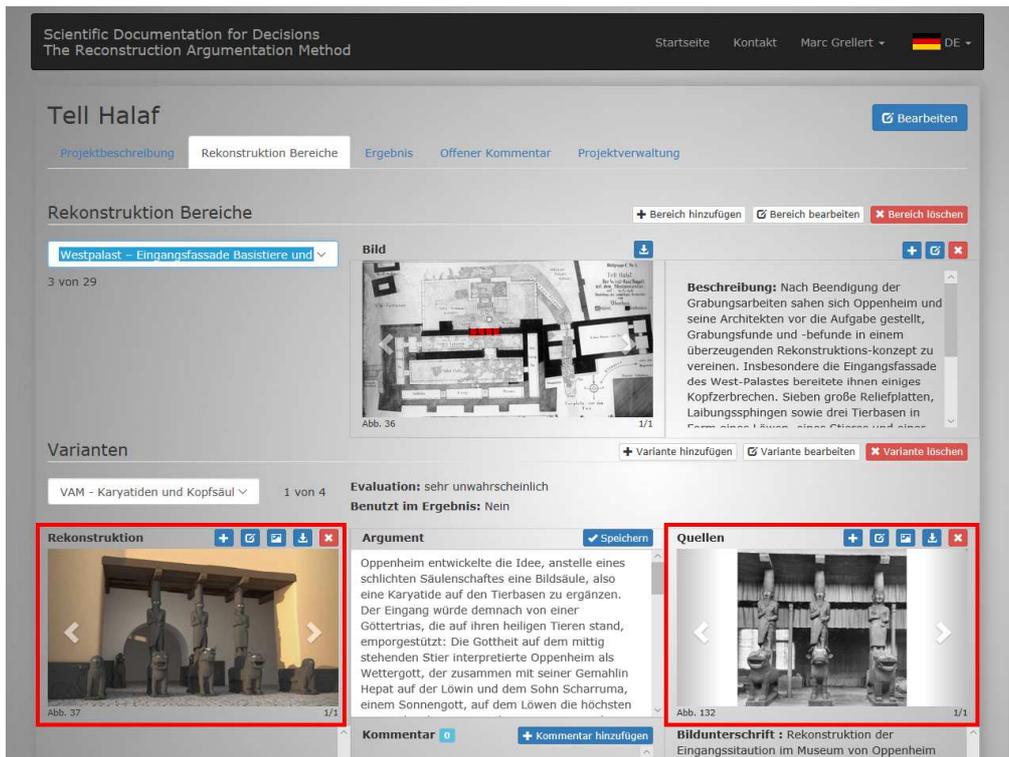


Fig. 6. Images reconstruction + source, variant 1, entrance facade, project Tell Halaf, screenshot www.sciedoc.org.

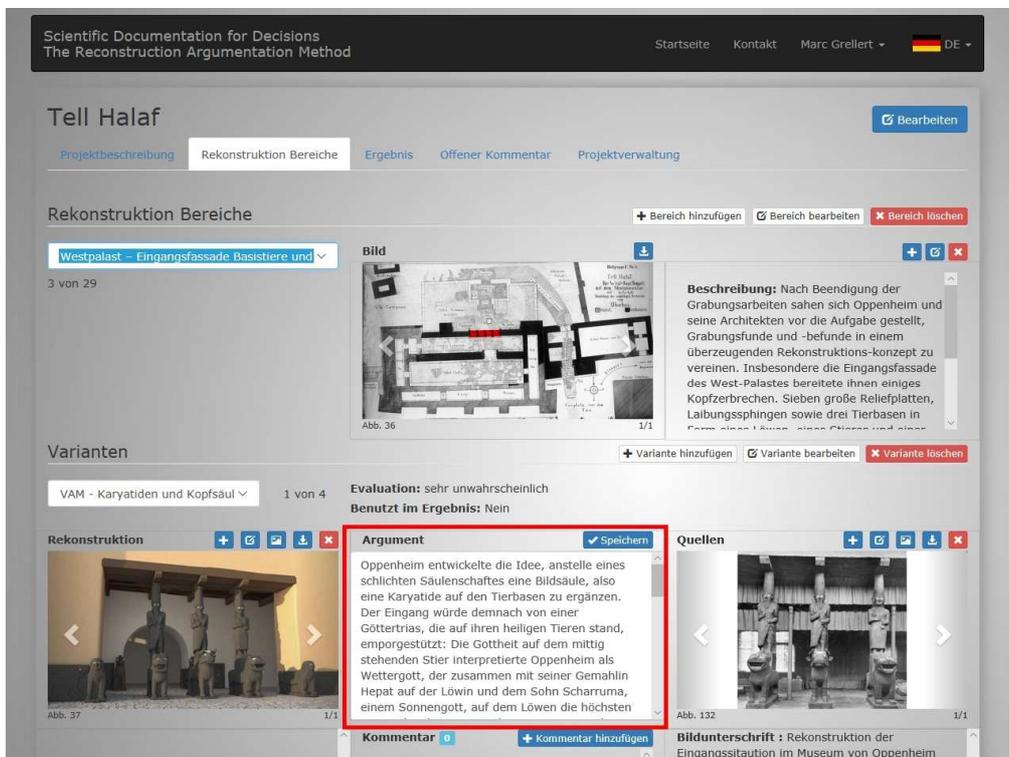


Fig. 7. Argumentation, variant 1, entrance facade, project Tell Halaf, screenshot www.sciedoc.org.

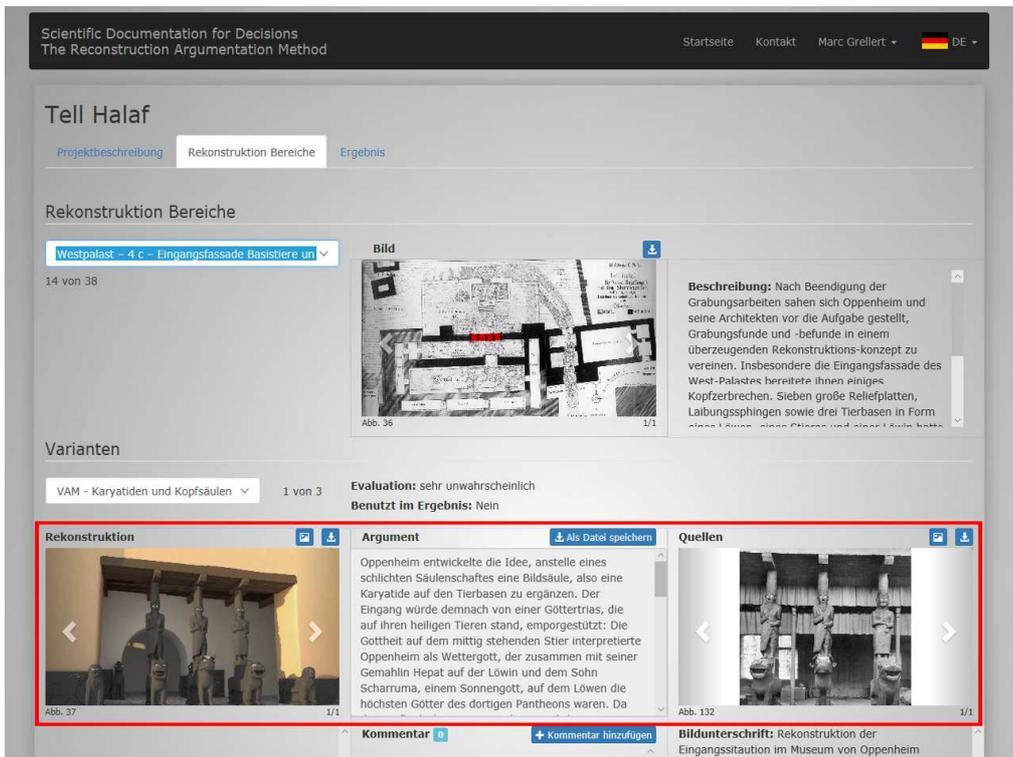


Fig. 8. Front end, Triad reconstruction – argumentation – source, variant 1, entrance facade, project Tell Halaf.

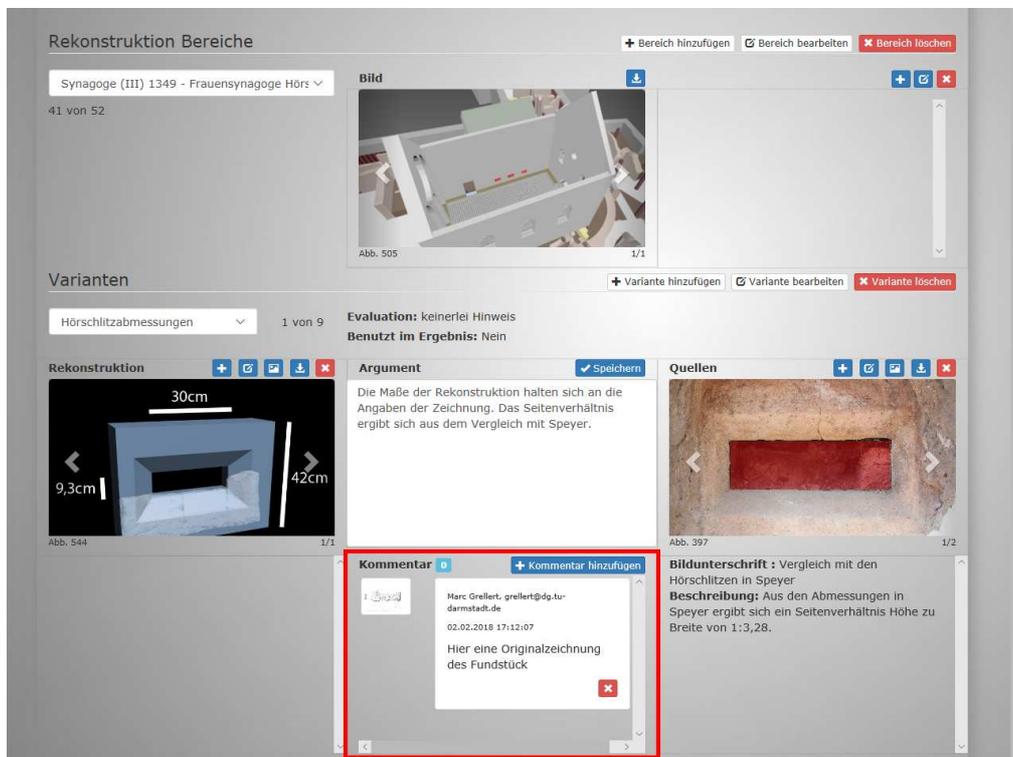


Fig. 9. Comment and image added to a variant, medieval synagogue Cologne, screenshot www.sciedoc.org.

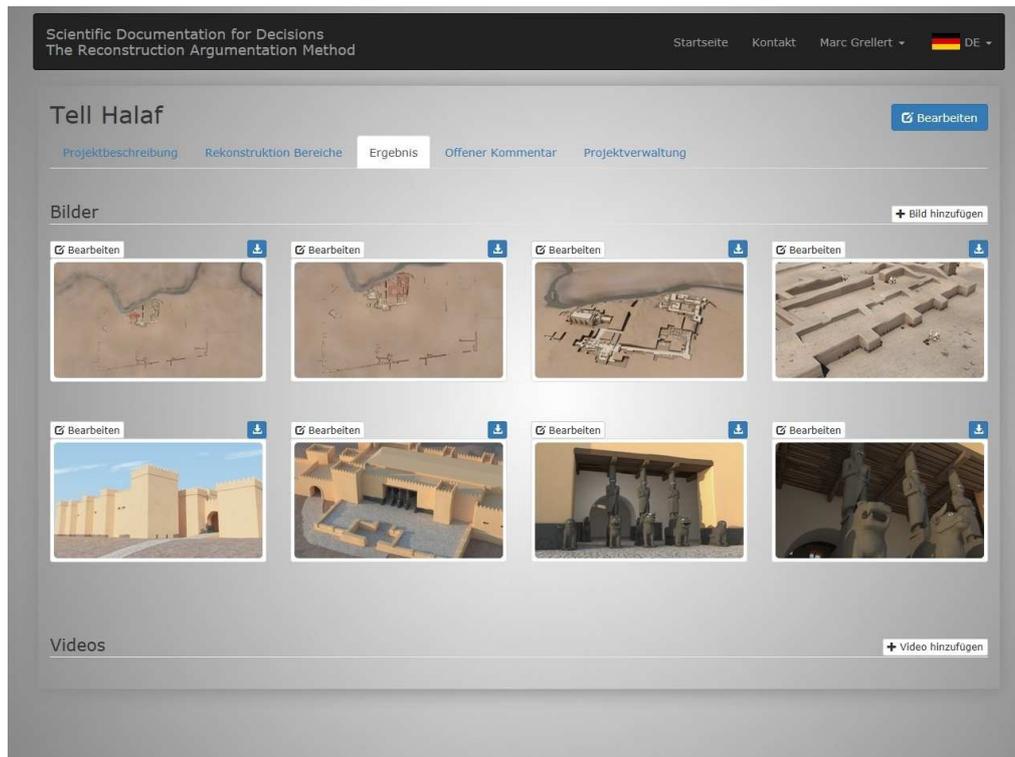


Fig. 10. Results, project Tell Halaf, screenshot www.sciedoc.org.

FIRST EXPERIENCES

Until now over 20 reconstructions are part of the data base but in different stages and with different backgrounds. There is a first reconstruction with a finished documentation online. Another finished one is until now just offline. Copyrights of the displayed sources have to be checked. There are ongoing documentations of finished projects and ongoing projects with no documentation so far. For example, a larger number of academic projects will come from the Technical University Vienna. In cooperation with Bob Martens, the reconstructions of destroyed synagogues will be documented in this way. Thus, in the future, there will be many experiences from academic and commercial reconstructions:

- Academic reconstructions
 - Larger research projects
 - Master thesis
 - Ordinary courses
- Reconstructions done in a commercial setting

The first experiences with the tool show that it is not only effective for the documentation of decisions after the end of a project but also for the communication with the scientific advisors during the reconstruction. For the Klenow castle the progress of the work was discussed with scientific advisors (Fig. 11).

Also in the field of teaching the first experiences with the tool are convincing. The students learn easier to work in a systematic way. And the online documentation is a state of the art format for showing the student work; for example, the reconstruction of the medieval synagogue of Cologne (Fig. 12).

Already now the use of the tool shows that the work procedure for a reconstruction was able to be systemized and in perspective also be standardized without bypassing individual work methods. The question is whether systematization can be so effectively developed that in the end through the use of the tool as a communication platform the documentation of the decisions is almost achieved and satisfies with little more work already the requirements of a scientific publication.

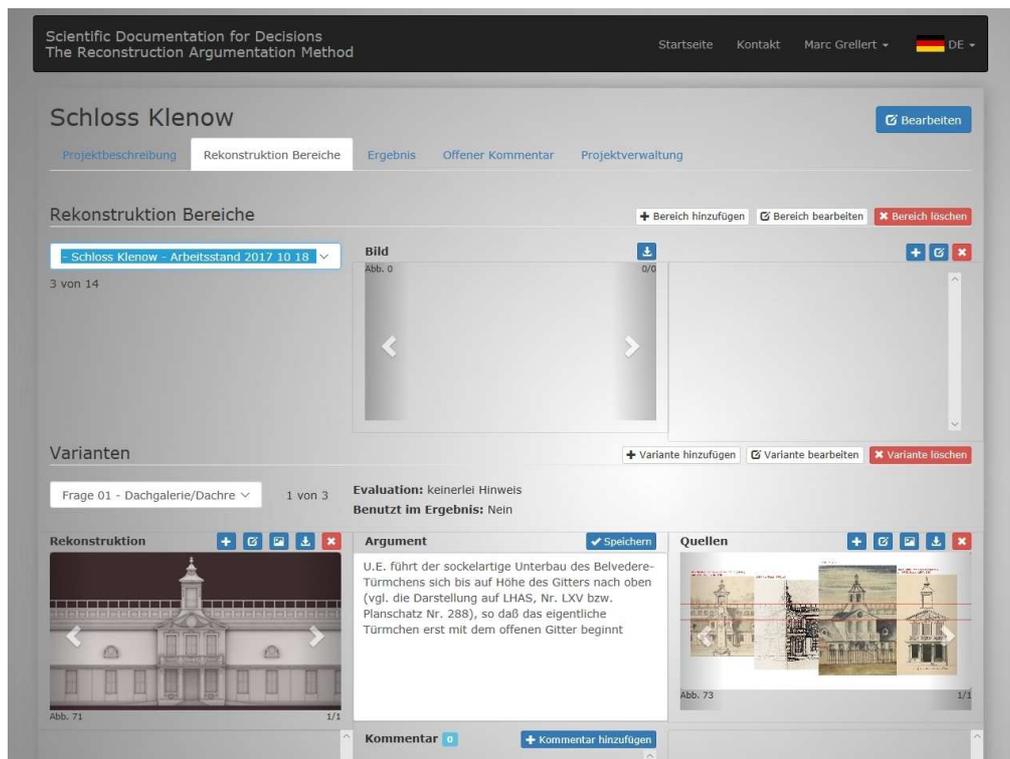


Fig. 11. Discussion with the scientific advisors. Klenow castle, screenshot www.sciedoc.org.

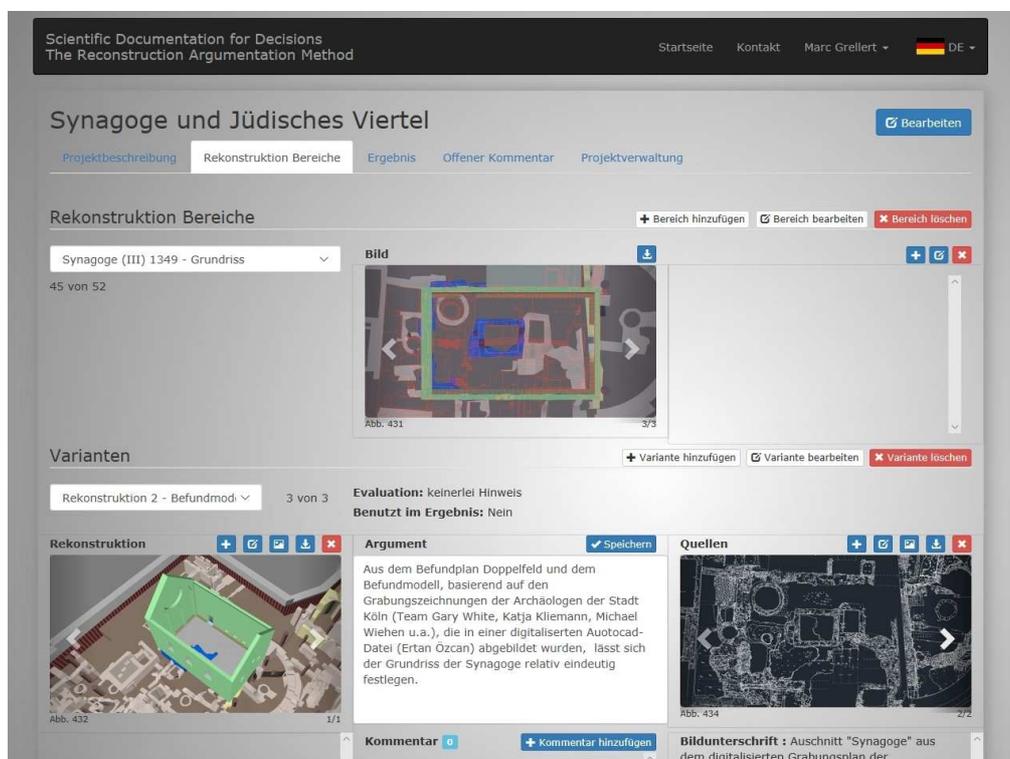


Fig. 12. Student project, medieval synagogue cologne, screenshot www.sciedoc.org.

THE DOCUMENTATION OF TELL HALAF

The Exhibition in the Bundeskunsthalle

In 2014, an exhibition about the life of the diplomat and archaeologist Max Freiherr von Oppenheim and his excavations on Tell Halaf in north-eastern Syria took place in the Bundeskunsthalle in Bonn [Kunst- und Ausstellungshalle der Bundesrepublik Deutschland 2014]. Part of this exhibition was a 15 minute film with a virtual reconstruction of the citadel of the Aramaic-Assyrian city of Guzana, the historical name of Tell Halaf [Grellert and Schmid 2015].

The reconstruction of the citadel and especially of its two most important buildings, the Aramaic Western Palace (Fig. 13) [Langenegger et al. 1950, p. 23–86] and the Neo-Assyrian Governor's Palace [Langenegger et al. 1950, p. 222–324; Heitmann et al. in print], was carried out by the Digital Design Unit at the TU Darmstadt in cooperation with the Tell Halaf Project at the Museum of the Ancient Near East in Berlin.

For the scientists at the museum the cooperation was not only interesting in terms of the result but also with regard to the process of reconstruction, as the focus of archaeological publications usually lies on the description and analysis of finds and findings. The development process of architectural reconstructions [Hageneuer 2014] is mostly neglected and is therefore not or only insufficiently comprehensible or verifiable.

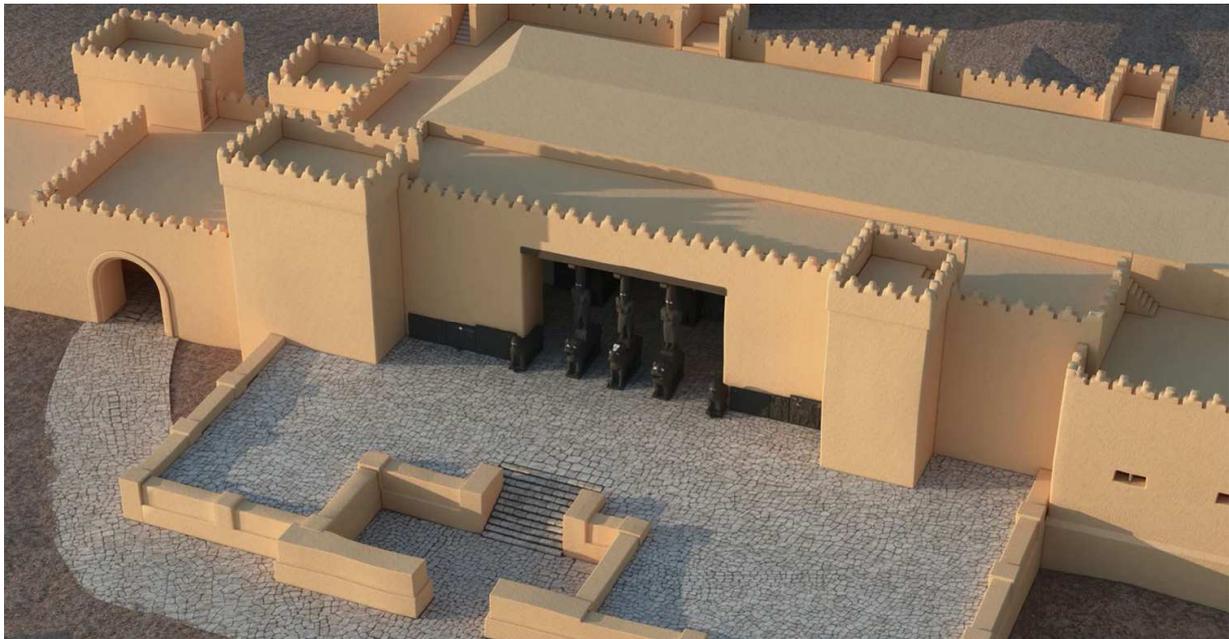


Fig. 13. Virtual Reconstruction of the Aramaic Western Palace, presented in the Bundeskunsthalle in Bonn.

The Tasks of the Documentation

A discussion, which went beyond the collaboration on the topic, developed about the question how a documentation of the reconstruction process could look like [Pfarr-Harfst and Grellert 2016]. A documentation which, on the one hand, documents the development as completely as possible but, on the other hand, does not require too much time and effort.

The individual aspects of the common deliberations were initially the most important tasks that a documentation has to fulfill. The main consideration was to make the decisions for and against certain solutions, which are done on the basis of the archaeological documentation, comprehensible and to point out developments in the working process, such as changes or clarifications.

At the same time, the documentation should allow an evaluation of the probability of a reconstruction as well as the presentation of alternative solutions. It was also important that the documentation could be updated and that new insights could always be added. And last but not least, it seemed desirable to be as variable as possible in the integration of sources, such as texts, drawings, photos, films, maps and so on.

The Input Structure

After the documentation tool was developed in Darmstadt on the basis of such considerations, the first task for the members of the Tell Halaf Project was to find a suitable structure for the input of our main buildings. The fundamental question was how to divide a building into single areas in order to achieve not only a complete but also an economic documentation. There were two ways to do this. The first possibility would be a layout similar to a room book that is common in building research and in which a building is documented room by room with all its details [Knopp et al. 1992, p. 79–81; Petzet and Mader 1993, p.178–179]. A second alternative could be the orientation towards so-called component assemblies, such as foundations, walls, windows and doors, floors or ceilings [DIN Deutsches Institut für Normung 1981; STL-Bau 2017]. Both variants have the advantage of being easily comprehensible to outsiders.

In this case – where only the foundations, the lower parts of the walls and the floors of the building are known – a solution approaching the second option seemed to us to be the more suitable one because many decisions were of general nature and would have been duplicated in an approach structured by rooms. Thus for the areas to be reconstructed, a hierarchy of “Building – Component – Location in the Building” was chosen (Fig. 14).

Furthermore, it is important to distinguish in the documentation tool clearly between the available sources and the arguments developed from them. A distinction between primary sources, such as findings, as well as secondary sources – written and pictorial evidences, examples of comparison or basic requirements – can also be made in order to assess the informative value of individual sources.

An example therefore is the categorisation of the photographs of the stone sculptures found in the entrance area of the Western Palace, which can be divided into five groups (Fig. 15):

1. Pictures showing the sculptures in their lost and found condition (left top).
2. Pictures showing how the monuments were put together and positioned on the site (right top).
3. Pictures which show the restored sculptures in the Tell Halaf Museum in Berlin before their destruction in the Second World War (left bottom).
4. Pictures showing von Oppenheim's replicas in the Tell Halaf Museum (right bottom).
5. Pictures that show the monuments today after the renewed restoration in the years 2002 to 2009 (middle).

While the first group contains the most objective information, but also the most incomplete, the images of the other groups are increasingly afflicted with interpretations, so that the individual groups have different degrees of expressiveness regarding the reconstruction.

Finally, the possibility of entering different variants for a structural detail and comparing them with each other is also to be mentioned. This is important, since a clear interpretation is often impossible, but a decision in the virtual reconstruction is unavoidable. Two examples from the Western Palace may illustrate this: the entrance facade of the palace [Grellert and Schmid 2015; Schmid 2016] and the upper end of the walls.

In the first example, all variants of the entrance show the base animals secured by findings in combination with different compositions (Fig. 16); first with statues of gods that were found in the entrance area but cannot be assigned to the base animals without doubt. Alternatively, the bases are accompanied by columns, with or without capitals.

In the second case, concerning the upper end of the walls, pictorial presentations suggest a crowning with crenellations but leave it open whether they sit directly on the ceiling or on a parapet wall (Fig. 17).

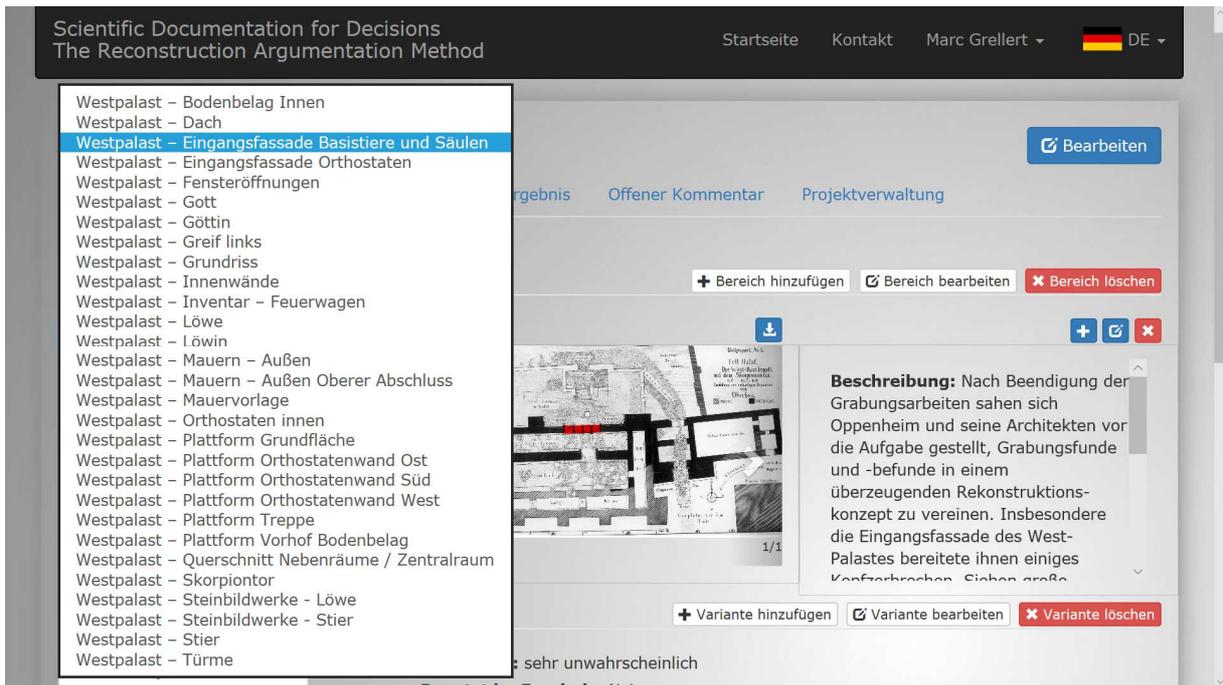


Fig. 14. Database-mask with the input structure for the Western Palace, orientated towards component assemblies.



Fig. 15. Pictures showing different states of an embasure sphinx as an example for the categorisation of the photographs. Lost and found condition (left top), put together and positioned on the site (right top), restored sculptures in the Tell Halaf Museum in Berlin before their destruction in the Second World War (left bottom), Oppenheim's replicas in the Tell Halaf Museum (right bottom) and monuments today after the renewed restoration in the years 2002 to 2009 (middle).

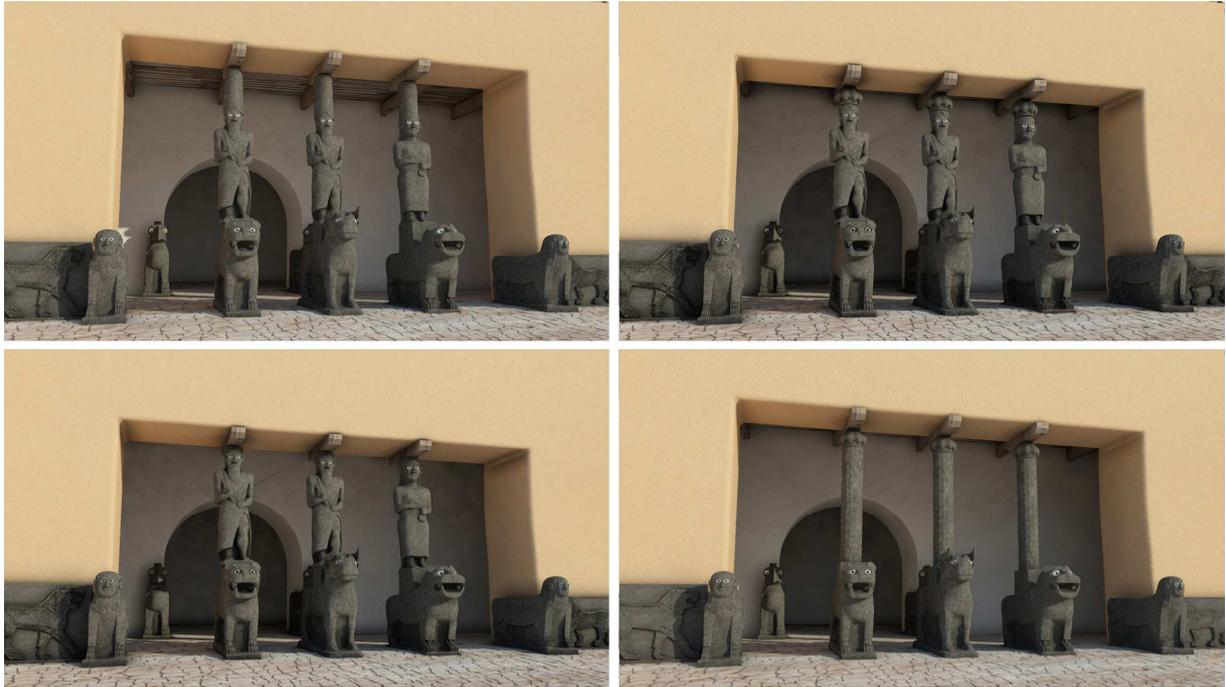


Fig. 16. Four variants of the entrance facade of the Western Palace: with statues of gods on the base animals or with columns.

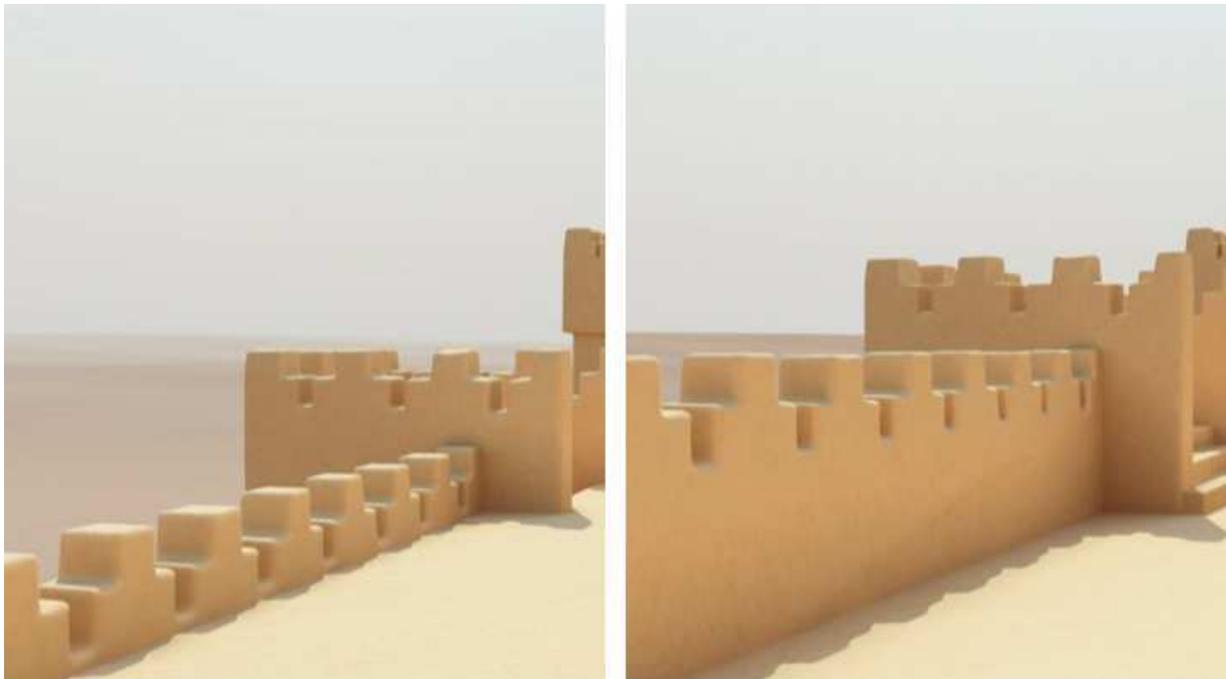


Fig. 17. Two variants of the upper end of the walls: in the first the crenellations sit directly on the ceiling, in the second on a parapet wall.

CLOSING REMARKS

The documentation of the decision process in the context of digital reconstructions is to be seen as part of a “good scientific practice”, as stated by the DFG – the German Research Foundation [Deutsche Forschungsgemeinschaft 2013]. Finally, from the recommendations of the DFG, five aspects shall be picked out as central themes and their specific use in connection to digital reconstructions and the newly developed online tool will be examined. This will also be done with regard to the background of the many discussions held for several years about, for example, methodology, sustainability, long term archiving and suitable documentation procedures in the working group “Digital Reconstructions” (www.digitale-rekonstruktion.info).

From the standpoint of today’s challenges in the field of digital reconstructions which are based on scientific knowledge, the following recommendations of the DFG are important as far as good scientific practice is concerned: first to work “lege artis”, second to consequently question all results, third to document results, fourth “scientific publications” (recommendation 1) and fifth, the safeguarding and storing of primary data (recommendation 7) [Deutsche Forschungsgemeinschaft 2013, p. 15].

„Lege artis“

“Lege artis” means to work in accordance to the current stand of science. In reference to digital reconstructions this means that these digital 3D models must be based on the latest developments in research. Hereby scientific support must exist for clearly proven as well as hypothetical areas within a digital reconstruction. Extensive inquires and careful fundamental investigations are a prerequisite. In order to guarantee this it is necessary as a rule to work together with specialists from disciplines such as archaeology, building history or art history.

“Consequently question all results”

In the case of digital reconstructions “to consequently question all results” means to allow alternatives and variants, to critically question and discuss them and to include them in argumentation. In this way, in a documentation it is essential to present both plausible variants and also variants where the plausibility has been questioned against a background of extensive analyses. This includes also variants of other protagonists not directly connected to the respective project. In the meantime, for this attempt to think in variants and to allow and not to be forced to produce clarity, there is also more and more an awareness by museums which are one of the most important customers for digital reconstructions. The project MiQua with the visualisation of “possible synagogues” (Fig. 18) is an example. For the special sector TV documentation and the use of digital reconstruction models one can be more skeptical. In this case, meanwhile the realistic photographic, clear-cut and thus uncritical presentation of an image from the past has been established and does not allow a reflection about a variant. However, for a scientifically based digital reconstruction in the sectors research, conveyance of knowledge, and safeguarding, it is absolute necessary to have a starting point orientated on variants and therefore this principle leaves its mark on the “Reconstruction Argumentation Method” and in www.sciedoc.org.

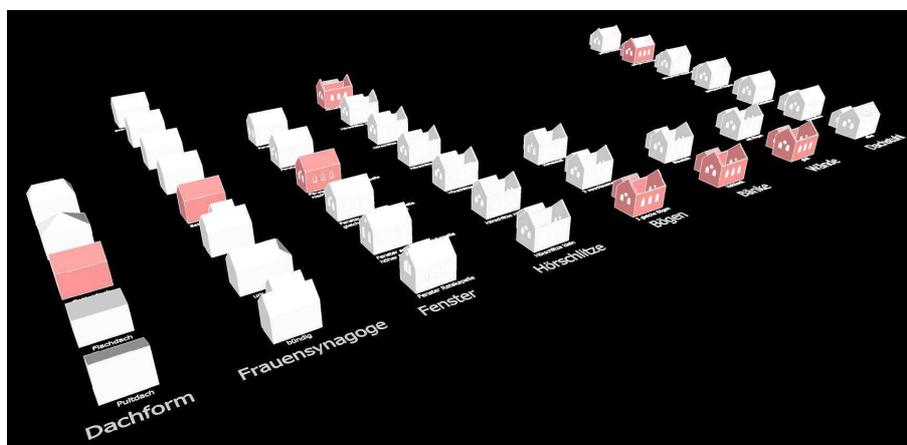


Fig. 18. Possible synagogues, project medieval synagogue Cologne.

“Documentation of Results” and “Scientific Publications”

The recommendation of the DFG for “Documentation of Results” is the core of the “Reconstruction Argumentation Method” and has already been depicted in detail. Furthermore, with the development of the described online tool, a basis for a possible form of a “Scientific Publication” has been established, which is always connected with the documentation of the results. The next medium-range step will now be to strive for the further development of the online platform in respect to the storing of interim stages as well as an institutional anchoring and connection to the already existing systems as recommended by the EU.

“Safeguarding and Storing of Primary Data”

At present no satisfactory solution has been realized for the last mentioned recommendation, “Safeguarding and Storing of Primary Data”. In order to do justice in this case to the digital reconstruction models, next to the pure safeguarding of the primary data also the original configurations of the hardware and software must also be safeguarded. In addition, an institutional anchoring is well-grounded to find solutions to be able to tackle the challenges such as emulations, long term readability of the data or the data exchange.

“Outlook”

Through www.sciencedoc.org and the underlying “Reconstruction Argumentation Method” already today four of the five discussed DFG recommendations are covered and can be made available to the community. There is the hope that many people will use this free tool. The goal is to come to an agreement as to how virtual reconstructions are to be documented in the future and to develop together standards. For example, standards about the level of plausibility, but also agreements about graphical representation of the level of plausibility, the kind of sources used for a reconstruction or different building phases. Of course, money is needed to elaborate this tool. Next steps could be automatic generated PDFs. The goal for the future should be to have a peer review procedure to examine the different documented projects. Further steps are to check out how much time this documentation method will take and thus to estimate also costs. Maybe this will help convince clients and public donors to give additional money for a documentation. A challenge will be to convince all holders of copyrights to allow using the source material online – a general challenge for all kinds of documentations.

REFERENCES

- Jonas Bruschke and Markus Wacker. 2015. Neuartige Werkzeuge für die Entwicklung und Dokumentation digitaler Rekonstruktionen. In TU Dresden, Forschungsförderung und Transfer, TechnologieZentrumDresden GmbH, Industrie- und Handelskammer Dresden, GWT-TUD GmbH (Hg.), *Dresdner Transferbrief*, Dresden.
- Emanuel Demetrescu and Bruno Fanini. 2017. A white-box framework to oversee archaeological virtual reconstructions in space and time: Methods and tools. In *Journal of Archaeological Science: Reports Volume 14*, August 2017, 500-514, <https://doi.org/10.1016/j.jasrep.2017.06.034>.
- Deutsche Forschungsgemeinschaft (ed.). 2013. Grundlagen guter wissenschaftlicher Praxis, from http://www.dfg.de/download/pdf/dfg_im_profil/reden_stellungnahmen/download/empfehlung_wiss_praxis_1310.pdf, version 15.06.2017.
- DIN.bauportal gmbh. 2017. STLB-Bau online. VOB-gerechte Ausschreibungstexte, Aktuelle Version 2017-10. Retrieved November 06, 2017 from <https://www.stlb-bau-online.de>.
- DIN Deutsches Institut für Normung. 1981. DIN 276-2. Kosten von Hochbauten. Kostengliederung. Berlin.
- Marc Grellert and Jochen Schmid. 2015. Oriental Adventures – The excavations at Tell Halaf – Syria. A Virtual Reconstruction. In *Museen der Stadt Wien – Stadtarchäologie (ed.) Proceedings of the 19th International Conference on Cultural Heritage and New Technologies 2014 (CHNT 19, 2014)*. Vienna.
- Marc Grellert and Franziska Haas. 2016. Sharpness Versus Uncertainty in ‘Complete Models’. Virtual Reconstructions of the Dresden Castle in 1678. In Stephan Hoppe and Stephan Breiting (ed.). *Virtual Palaces, Part II Lost Palaces and their Afterlife, Virtual Reconstruction between Science and Media*. München, 119–148, <http://www.courtresidences.eu/index.php/publications/e-Publications/#Volume%203>, version 06.07.2017.
- Sebastian Hageneuer. 2014. The visualisation of Uruk. First impressions of the first metropolis in the world. In *Museen der Stadt Wien – Stadtarchäologie (ed.) Proceedings of the 18th International Conference on Cultural Heritage and New Technologies 2013 (CHNT 18, 2013)*. Vienna.
- Raphaela Heitmann, Elisabeth Katzy, Mirko Novák, Jochen Schmid, Uwe Sievertsen. In print. Studien zum

- Assyrischen Statthalterpalast, Tell Halaf VI. Wiesbaden: Harrassowitz.
- Gisbert Knopp, Norbert Nussbaum und Ulrich Jacobs. 1992. Bauforschung. Dokumentation und Auswertung. *Arbeitsheft der rheinischen Denkmalpflege* 43.
- Piotr Kuroczyński et al. 2014. Digital Reconstruction of Cultural Heritage – Questions of documentation and visualisation standards for 3D content. In Marinos Ioannides et al. (eds.). *Digital Heritage. Progress in Cultural Heritage. Documentation, Preservation, and Protection, 5th International Conference, EuroMed 2014, Limassol, Cyprus, November 3–8, 2014, Proceedings*. Heidelberg, <http://www.academia.edu/9189049/>, version: 17.06.2016 .
- Kunst- und Ausstellungshalle der Bundesrepublik Deutschland (ed.). 2014. Abenteuer Orient. Max von Oppenheim und seine Entdeckung des Tell Halaf, Tübingen: Wasmuth.
- Felix Langenegger, Karl Müller and Rudolf Naumann. 1950. Tell Halaf. Zweiter Band: Die Bauwerke. Berlin: De Gruyter.
- Michael Petzet and Gert Mader. 1993. Praktische Denkmalpflege. Stuttgart, Berlin, Köln: Kohlhammer.
- Mieke Pfarr. 2010. Dokumentationssystem für digitale Rekonstruktionen am Beispiel der Grabanlage Zhaoling, Provinz Shaanxi, China, TUprints, Darmstadt, <http://tuprints.ulb.tu-darmstadt.de/2302/>, version 29.06.2017.
- Mieke Pfarr-Harfst and Marc Grellert. 2016. The Reconstruction – Argumentation Method. Proposal for a Minimum Standard of Documentation in the Context of Virtual Reconstructions. In *M. Ioannides et al. eds. EuroMed 2016, Part I*, LNCS 10058, pp. 39–49, 2016. DOI: 10.1007/978-3-319-48496-9_4.
- Jochen Schmid. 2016. Material monumentality or virtual multiplicity. The palace facade of Tell Halaf as part of the reconception of the Museum of the Ancient Near East. In *Museen der Stadt Wien – Stadtarchäologie (ed.) Proceedings of the 20th International Conference on Cultural Heritage and New Technologies 2015 (CHNT 20, 2015)*. Vienna.

COPYRIGHTS

- Figs. 1–10,12,14,18 Technische Universität Darmstadt, Fachgebiet Digitales Gestalten
- Fig. 11 Architectura Virtualis Darmstadt
- Figs. 13, 16–17 Technische Universität Darmstadt, Fachgebiet Digitales Gestalten in Kooperation mit Architectura Virtualis GmbH, Kunst- und Ausstellungshalle der Bundesrepublik Deutschland, Vorderasiatisches Museum, Staatliche Museen zu Berlin – Preußischer Kulturbesitz
- Fig. 15 Archiv der Max Freiherr von Oppenheim-Stiftung. Köln, Tell Halaf-Restaurierungsprojekt, Berlin
- In the following figures (screenshots of websites) part of the screenshots are images from other copyright holders.
- Figs. 2–8, 14 Archiv der Max Freiherr von Oppenheim-Stiftung. Köln, Tell Halaf-Restaurierungsprojekt, Berlin, Langenegger et al., 1950, Architectura Virtualis GmbH, Kunst- und Ausstellungshalle der Bundesrepublik Deutschland, Vorderasiatisches Museum, Staatliche Museen zu Berlin – Preußischer Kulturbesitz.
- Fig. 11 Staatliches Museum Schwerin, Landesbibliothek Mecklenburg-Vorpommern Günther Uecker, Landeshauptarchiv Schwerin
- Fig. 12 Stadt Köln, Archäologische Zone

Imprint:

Proceedings of the 22nd International Conference on Cultural Heritage and New Technologies 2017. CHNT 22, 2017 (Vienna 2019). <http://www.chnt.at/proceedings-chnt-22/>
ISBN 978-3-200-06160-6

Editor/Publisher: Museen der Stadt Wien – Stadtarchäologie

Editorial Team: Wolfgang Börner, Susanne Uhlirz

The editor's office is not responsible for the linguistic correctness of the manuscripts.

Authors are responsible for the contents and copyrights of the illustrations/photographs.