1 Introduction

The question of what is "meaningful" and about the potentials of digital medium in terms of the use of computers in the area of architecture, is still much discussed and disputed. The matter for discussion is above all the use of computers in order to represent reality and to visualize our built environment in the form of 3D models. There is aversion to the use of computers as well in archaeology. Archaeologists are hardly inclined to recognize computer-generated pictures as scholarly. In both disciplines, architecture and archaeology, the misunderstanding lies in the use of computers only as a means to generate descriptive pictures. Computers can do more. The representation of processes and the simulation of complex procedures is, in other sciences, a common operational area of computer models. In numerous projects today, co-operation between architects and archaeologists is common. This fact strengthens the possibility for establishing and deepening communication between both sciences on a new basis.

This conference paper presents the process status of the research project „Development of an interdisciplinary, digital communication system for the research and visualization of settlements using the example of the deserted, medieval village of Marsleben“ [For05] The project is funded by the German Federal Ministry of Education and Research (BMBF).

It is the task of the research project to methodically develop, program and initially use a digital communication system for scientists by the example of the remains of the deserted settlement Marsleben near the UNESCO World Heritage town of Quedlinburg in Saxony-Anhalt, Germany.

The project does not have the goal of criticizing the past work of the scientists in question. Rather, the developing research results should be an extended offer for the work of archaeologists, architects and other scientists in the field of the settlement research, in order to further strengthen co-operation. By a comprehensive analysis of all partners' current working methods and visions for "lively" means of co-operation, the way for a functioning and effective interdisciplinary work can be smoothed. At the same time, the possibilities for informing the public about the working conditions, intermediate results and the latest realizations of the scientists should be implemented by using suitable visualization forms which also leave room for individuals' interpretations.
2 Material & Methods

2.1 Initial situation and subject of investigation

Because of the reduction of financial support, the Cultural Heritage Sector has to face major changes. Due to the reduction in funds, it is to be expected that personnel resources must be decreased. The future fields of work of archaeologists lies less by those where personnel and finances are demanded for complex fieldwork, but rather in the treatment and interpretation of finds and findings. For the preparation, evaluation and presentation of collected data the necessity exists to bundle research work and create research groups. This will enable archaeologists to more effectively access the knowledge of different research disciplines. In general, the research process can be processed more efficiently. Presently, archaeological research lacks technical cross-linking with other disciplines, which is necessary in order to get better interpretations in shorter times. Success that is possible through interdisciplinary networks is demonstrated in individual projects in the area of the archaeology where co-operation with the natural sciences contribute to a crucial degree. [Sto94].

A great challenge for scientists lies in the research and reconstruction of the remains of settlements which have been deserted, as well as their surrounding countryside. Because of their complexity, these research projects are connected with special demands on the co-operation among different research disciplines. All the deserted settlements, whether partial or total, permanent or temporary have the common characteristic that they no longer exhibit visible structural remnants in the soil. All parts found underground of a settlement are relatively clear, although partly disputed in their dating. In deserted settlements finds above the earth’s surface are no longer present. The term of the "uncertainty of the knowledge" [Die04], describes the vagueness of the past and must be recognizable in visualizations.

In order to investigate and reconstruct settlements, complex natural and anthropogenic influences on settlement development and deterioration must be taken into account. The related sciences cooperating in settlement research; settlement archaeology, settlement geography and settlement history cover a broad spectrum of scientific fields of activity [Jan77].

For scientific research, for reasonable reconstruction and consequentially their effective visualization for the public, different specialists must cooperate. Despite modern digital communication systems, the necessary interdisciplinary knowledge exchange on digital basis hardly takes place. Survey data show that there is almost no common discussion basis to date. The reasons can be found in the different technical and historically based work methods.

It should be scientific practice to work interdisciplinarily. In reality, information exchange does not yet exist to the necessary degree. An upheaval in the structures is partly generation dependent. Also, new funding guidelines require change in regards to group research projects on a broad basis. A cooperative communication basis, which unites the different functions and ways of thinking, is an initial condition for successful interdisciplinary, location-spreading co-operation. “The composition of an interdisciplinary team is
fundamental for beginning a project of a 3D virtual reconstruction, and a good final result depends mainly on this” [FBS00].

The representation of settlements, e.g. in the form of computer generated pictures, is highly speculative and for scientific work only usable to a small degree. 3D models embedded into a working process in connection with other media, e.g. pictures, films, texts, GIS data etc., have nevertheless a high value for the scientific work within settlement research. Preliminary talks and interviews with archaeologists, building researchers and historians showed that the computer in the settlement research is usually not used accordingly to its potential. It is an advantage of computers that structures, objects and processes can be changed in a way that the recipient receives representational images at almost any time. By an increase in the efficiency of working processes (arithmetic operations per time unit) a facilitation of work for humans is created. In some cases solutions for scientific questions are only made possible by the assistance of the computer. Procedures with a very high complexity can be changed and presented continuously, e.g. flood simulations, light simulations, pattern recognition in ceramic research.

For archaeologists, the computer offers more than just a data base and the possibility of text input and views of photographic images. On the basis of numerous projects from scientific practice at the VAST Conference, 2005 (Virtual Reality, Archaeology and Cultural Heritage) [Vas05] it became very clear that archaeologists want to use digital models. In order to be accepted in scientific work, these models must document research processes. Scientists want to see the process, e.g. for reconstruction and not only the final version of a picture. In order to be able to participate in the discussion, new systems and discussion tools must be made available. The handling of 3D models for archaeologists must be simplified. The attempt of the Technical University of Graz to program a "3D modeling kit for non-expert users" [Hav05] appears to be promising. During the development however the balance between standardization and individuality of objects should be examined critically and discussed with archaeologists.

2.2 Methodical Approach

The research project is arranged into three main phases. In the first phase the basic determination, analysis and conception of the communication system is accomplished. In this phase the methodical bases is built. Scientists and the public are involved into the development of the system by questionings and prototype tests. In the second phase the system is programmed by media technicians and computer scientists and used in the third phase by the example of Marsleben. For this initial project different sciences will cooperate location-spreading with the digital communication system. To the team momentarily belong: archaeologist, architects, urban planners, media technicians, building researcher and art historian.

The challenge and difficulty is to find out what different communication tools scientists need and how one can link the diverse communication media meaningfully. The methodic examination of this question and the development of solutions is task of the first phase of the research project.
In order to find out, how communication in the settlement research can be supported by a digital system in the future, the past functions in the subsidiary sciences separated so far must be analyzed. The system will be specified on the basis the momentary single methods and by deficits and goals that one can convert into computer program structures.

The results of the analysis are discussed in an empirical investigation in the form of personal questionings with future users and transferred into a program concept. Technical and content wise aspects must be considered and will be connected in a graphic user surface (GUI) in a way that the system can be used in the Internet by all scientists involved.

The achieved research results will be used for the improvement and future use i.e. for further projects of this kind. Target group are above all archaeologists and building researchers, who are working with the data evaluation following large excavations. It will be also of interest for scientists of different disciplines, who work on the research of settlements and want to present there knowledge to the public.

3 Results

Publications within the range of the Cultural Heritage and reconstructions can be found numerous in scientific data bases. Within the projects the part of the reconstruction and visualization, apart from a few exceptions, has always the public as a target group. In order to support scientific work, 3D models are not used so far. Nevertheless usually models are the only still visible result of the work after the years and the end of the research project.

The data presentation dominates the data collection and data interpretation in the public recognition. The projects are noticed thereby beyond the scientific expertise.

The current scientific discussion takes up numerous problems in connection with interdisciplinary co-operation in the Cultural Heritage sector and confirms thereby the actuality of the research topic. The VAST conference 2005 (Symposium on Virtual Reality, Archaeology and Cultural Heritage at Pisa), the EVA conference 2005 (Electronic Imaging and the Visual Art at Berlin) and the international conference "Cultural Heritage and new technologies" in Vienna in November 2005 verify many of the set up research theses.

For the projects investigated on the conferences and by other sources a data base in Windows Server SharePoint system was provided.

The data base covers further criteria, which evaluates interdisciplinary emphasis of the project in the reference to archaeology, architecture and technology apart from the usual data records, like author, title and publication place /-kind. With the help of the data base it was possible to create further selection criteria and to define important projects for the further investigation. In addition the target group, depending upon project emphasis, was determined as public or scientist. This is necessary in order to exclude pure visualization projects from the analysis. These visualizations of service providers serve e.g. cities and municipalities to generate financial resources. The connection to scientific work could not be reconstructed with such projects by the existing material. The generated pictures hardly possess information content and are not supplemented by additional information. With the
help of the database 17 relevant projects were picked out from over 60. The selected and analyzed projects are sorted chronological as follows:

- **Prehistoric settlements** – 7th century BC – 1st century AD [Dre06]
  Aksum, Ethiopia; Catal Höyük, Turkey; Qatna, Syria; Troja, Turkey
- **Roman settlements** – 2nd century BC - 4th century AD
  Aventicum, Italy; Carnuntum, Austria; Colonia Ulpia Traiana, Germany; Jülich, Germany; Sagalassos, Turkey; Via Appia, Italy; Wien, Austria
- **Medieval settlements** – 5th century AD – 1500 AD
  Bologna, Italy; Dürnstein, Austria; Oudenaarde, Belgium; Lauchheim, Germany; Turku, Finland; Zürich, Switzerland

As a result of the preliminary investigations the following deficit hypotheses are defined as the basis of the momentary situation in the settlement research:

*At the present research results in settlement research are rarely exploited.*

Scientists have difficulties to mediate the specialized knowledge to the public. The conventional media, such as texts and pictures, are very limited suitable for the public-effective presentation. Digital 3D models impart a better impression of settlement processes in the landscape. Many projects show models. These usually contain:

- no links to other information within the system
- the character of presentation models only
- no representation of the archaeologically proven findings
- no recognizable distinction between hypotheses and real findings
- a limited scientific requirement
- a small interactivity by limited navigation possibilities
- very loose connections to scientific map material
- no references to other scientific disciplines

*The expenditure for the preparation of archaeological data records for the settlement research is very high. Within the range of the data collection there are no digital standards.* In parts the data is still recorded analogue. The project manager of the individual project decides about the technical specifications of the excavation. The training of the co-workers and the goal of the excavation, are likewise crucial for the usability of the data for the further treatment.

*Between the involved scientists data and knowledge in the settlement research is still exchanged over conventional communication tools (Email, telephone, fax, post office). For scientists no specialized digital communication system is available for settlement reconstruction to discuss and present facts and questions.* In education and science within the universities it is nowadays expected that students handle multimedia as a matter of course [UHa02]. The generation of the archaeologists, building researchers and historians that use the possibilities of the digital techniques is developing at the moment.
The prolonged use of digital communication systems for other research projects in the settlement research is hardly given. Only in very few cases special communication tools beyond standard applications were used. These solutions represent applications developed for the single case study.

There is no digital tool for settlement modeling that can be provided to the scientist to be used independently and without high training course. The production of models is incumbent on specialists of programming in the area of multimedia, which have few knowledge of settlement research. The archaeologists do not create models and are not specialized enough to prepare knowledge for the public as teaching materials. Independent modeling presupposes extensive knowledge in the use of 3D software.

An updating of the state of knowledge in the 3D model is fundamental to the scientific work. The documentation of a process of knowledge makes it comprehensible. This fundamental scientific requirement must be considered in visualization likewise. The acceptance of models and computer images can be increased.

In settlement research one evidently works with different media. These data (3D-Models, texts, photos, data bases, films, GIS, CAD) is usually not linked among themselves in the digital systems. Because of the present separation of content and navigation the user is unable to connect information’s between the individual parts of the information system and publications in digital form on CD, DVD or in the Internet.

A continuous participation of the public into the current research process by responding, understandable and informative presentations does not exist at the moment. The public is increasingly interested in prepared scientific contents. The awareness for the visitors of museums and exhibitions must be wakened by the scientists, in order to secure and finance their work on a long-term basis. Momentarily a gap between the perceptions of the visitors and the researchers exist. The visual presentation of complex circumstances in the form of pictures, diagrams and films, must be strengthened.

The settlements from three time epochs were examined particularly for the represented deficits showed above. The deficit hypotheses were sent out by questionnaires to the project managers. The evaluation of the deficit hypotheses oriented to the aims of the research projects will be processed in the following working step.

4 Conclusion & Outlook

The data recorded in the archaeological excavation of the project partner „Archaeological Heritage Board Saxony-Anhalt“ (LDA) is completely available to the research team. The quality of the excavation documentation of the settlement Marsleben is to date, far beyond the standard for excavations. In May 2006, a publication with the title: "Digital data acquisition with archaeological excavations - representation of Potentials of integrative systems by the example of Marsleben” will be published. It will report on the data that was recorded during the excavation work of Marsleben. The publication in the technical periodical "Geo Bit" will describe the documentation technology used by the LDA.
The work on the research project will be continued following the working schedule. For the next steps, the analysis of relevant subtopics is substantial. The single components of the settlement research will be analyzed by their data input/output as well as their methods. The results will be transferred into an integrative concept for digital co-operation. In the conception phase, it will be possible to determine how communication has to be structured and converted by programming. The work process of the scientists and the presentation of partial results for the public are the two main emphases of the project. For the presentation of the scientific progress, an information system was programmed in Macromedia Flash MX and installed on a computer terminal. It will be integrated into the exhibitions on the Middle Ages at the Museum of Quedlinburg by the end of April, 2006. For visitors, it will be possible to study the research almost in real-time. The progress in the project will be kept transparent by a constant exchange of data. The content, layout and navigation of the visitor presentation system will be evaluated with log files (statistics over the visited hyperlinks), personal questionings and on-line questionnaires and adapted if necessary.

Fig. 1: Screenshot of the presentation system for the museum
5 References


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