Argumentation paths in Information Infrastructure of the Archaeological virtual realities

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Efficient documentation and annotation of digital multi dimensional data, is a critical challenge for contemporary research in virtual archaeology. Means to document precisely also the increasing amount of stored in, and derived from the archaeological virtual reality simulations has grown an essentiality. This paper discusses documentation and management issues of archaeological virtual reality documents. The focus is on defining theoretical premises for managing VR as a feasible research tool and a communication media in archaeology. The issue is conceptualised by using theories of argumentation (Freeman 1991, Kircz 1991, Sillince 1992) and of infrastructures (Star and Ruhleder 1994, Star 1995). An outline of “argument paths” method is developed for an approach of enhancing usability of the archaeological virtual realities as publications.

Introduction

Virtual archaeology suffers from a paradox of lacking and an overload of resources. From a researcher’s point there is seldom enough information on a particular site or subject to make satisfactory virtual representations of the past. From an information management point of view, virtual archaeology produces information and archivables in such amounts that their efficient storage and occasional retrieval becomes a critical issue. The key for managing both, the non-existent information and as a consequence, approximations and inconsistencies, and the existing data in the virtual models, is to develop functional measures for efficient and communicative documentation.

This article discusses documentation and usage issues of virtual reality documents in archaeology from the information management point of view. The focus is on defining theoretical premises on how and based on which grounds, a VR is a feasible research tool and a medium of communication in archaeology. The issue is conceptualised by using argumentation (Freeman 1991, Kircz 1991, Sillince 1992) and infrastructures (Star and Ruhleder 1994, Star 1995) approaches. From this discussion a proposal of “argument paths” is derived for an approach of enhancing usability of the archaeological virtual realities as publications and information storages. Special emphasis is placed on supporting the functionality of the document by documentation strategies.

Archaeology and Virtual Reality

During the period from the mid 1990's to the present, archaeological and cultural heritage applications using different multidimensional visualisation techniques have rather clearly established themselves as a one standard procedure and concept in the archaeology computing and cultural heritage sectors. A quick survey over recent literature gives an impression that the techniques have penetrated rather widely the archaeological work procedures. The use of the virtual reality technologies does however, vary considerably from one expedition and excavation to another, and the dissemination of the skills and experiments seem to be still geographically somewhat uneven, depending on institution and country. In Europe, the EU development, research and technology programmes have lead to a number of advanced projects and development in low-resource countries, but the actual involvement seems to depend considerably on participants personal skills and interest.[i]

Then what is an archaeological VR? An important aspect of a virtual reality is in its non-linear structure. Virtual realities do resemble, in this respect, hyper-texts, which are also descendants of the digital era making non-linear, a standard of publication. Another aspect draws from the question of what is a virtual and what is a reality. Thinking of the meaning of the term virtual reality, such a construct representing a historical subject, can hardly be an accurately measured theory-free three-dimensional sibling of cross-sections and plans, despite this approach was rather strongly argued by Gaiani (1999). Unlike a multi-dimensional visual documentation technique to which Gaiani essentially refers to by using the term, a proper virtual reality should on my consideration defined rather as a dynamic projection of an assumed past reality following a suggestion by Barceló (2001). According to the term, a virtual reality ought to be a virtual interpretation of essentially real phenomena. A multi-dimensional document can be a representation of recent field documentation work, it can be such a document complemented with assumptions, hypotheses and theories, or it can be a simulation of the past reality only when it can be a virtual reality. An important aspect not to bypass is still that as a simulation a VR is still a theoretical composition, not a reality, nor belonging essentially to reality (Barceló 2001, Millette 2003).

A rather nihilistic view on virtual archaeology and archaeological virtual realities[ii], is functional especially because of the challenges regarding the illusion of false completeness easily summoned by photorealistic presentation. (Eiteljorg 2001) As a plan drawn by an excavator is never completely theory-free, a virtual reality of the past as a cumulative of multiple archaeological and historical sources is in absolute and in relative terms considerably far less theory-free. Therefore an essential value in creating a virtual reality, or “writing space” (ref. Bolter 1990 and 1991), as might be said, and in studying it, or similarly “reading the space”, is in the educated argument of the archaeologist responsible for the virtual reality. The value of an excavation report is in reporting minute details, but the value of an archaeological virtual reality is in distinguishing the essentials from the secondary information.

Multiple dimensions of archaeology

Different uses of virtual archaeological applications do raise a question on degrees and consequences of usage. Many of the possible practical applications of VR in archaeology proposed by Maurizio Forte (2000:250-251) have by now, if not had by then, been realised in various projects, and a number of new uses for the techniques have been introduced since then. Another question on the extents of virtual archaeology as a phenomenon presented in the same article (Forte 2000:250), has received, on the contrary, considerably less attention.[iii] Despite the diversity of projects and definitions of, and the definitions used of, virtual reality applications, the overall aims of VR in archaeology have remained more or less the same from the beginning. As a provocative generalisation might perhaps be argued that most of the researchers being aware of the conceptual problems regarding the visualisations in general, do wash their hands of the problem by emphasising their scientific and scholarly aims over providing aesthetic images. It is highly questionable whether the rationale and the significance of VA for the archaeology as a scientific discipline, have been explained or adapted to the practical applications consistently.

The thing in the VA is not in creating a spatio-temporal simulation of a past structure or phenomenon. The thing is how this practical achievement does progress scientific research and in general, increase understanding of the past. Barceló (2001) discusses the question insisting on the imperative of implementing a true interactivity by placing the focus on the communication aspect in the virtual, before the user experience can enter to a virtual reality proper. Emphasising communication may be grounded also on the derivative of the most commonly presented explicit motivations for creating VA applications, which is by no doubt disseminating knowledge of the

past in the sense of communication. (Forte 1997:12) The communication, as referred here, has to be understood as a rather inclusive concept to consist of communication of a scientist to him/herself, communication within the scientific community and communication of science to the general public. In this sense even the personal research motive of creating virtual realities may be seen as a communication where a scholar arranges source data in a manner that the data communicates its essential information content back to the scholar him/herself.

Aspects of the communicativeness of the archaeological virtual realities have been recognised as a grave practical problem during recent years from the documentation point of view which is a familiar one for archaeology. The fear of not being able to deliver information on the accuracy of archaeological data and the premises on different interpretations to the audience has lead to a discussion on practical ways of documenting the models properly in scientific sense. (e.g. Ryan 2001, Pekkola 2002, Niccolucci and Cantone 2003, Vatanen 2003) As noted already (Vatanen 2003), the debate has been focused, from a quite atomistic point of view, on rather mechanical issues of inserting this-and-that kind of metadata to the documents, instead of discussing also how and for what purpose the VR is actually expected to be used, and how the practical usability could be supported.[iv]

Barceló refers to Hollan and Stornetta article of 1992 “Beyond being there” which discusses the problems of assuming that traditional face-to-face communication functions on computerised environment. This basic observation is indeed confirmed as a correct one by a number of usability trials (e.g. Chen and Czerwinski 1997, Westerman and Cribbin 2000, Büscher et al. 2001). The complete picture is however by no means an uncomplicated one, and a functional usability springs from an amalgam of adapting both traditional and novel communicative techniques and approaches. Complementing the earlier observations, more recent research on the premises of human-computer interaction (HCI) and especially on the computer supported collaborative work (CSCW) has suggested a number of functional approaches to tackle the problem.

A rather widely discussed paper “Steps towards an Ecology of Infrastructure” by Susan Lee Star and Karen Ruhleder (1994) examined a collaborative computerised environment called Worm Community System (WCS) used by biologists studying genetics. The authors conceptualised the focus of their research by using a concept of an infrastructure to make visible the choices, politics and relations traditionally invisible in the structures. Star and Ruhleder view on infrastructure is to understand it as a relation between different entities than an entity, or a thing, itself. The concept has been referred to especially in literature on (management) information and knowledge systems, CSCW and classification (Bowker and Star 1994, Monteiro et al. 1994 etc.).

The point where genetics, collaborative work and infrastructure meet archaeological virtual realities, is at possessing a common aim of making something collectively known and used. Even though a VR is not a work group, strategies learned in and applied by CSCW research provide useful ground for enhancing the communicative capabilities of archaeological virtual realities. Archaeological VR is a dynamic (in the sense of historic processes, and the transitions in the archaeological stratum and the model, see Barceló 2001:224-229) multi-actor (the historic creators and users of the present material cultural remains, excavators, researchers, public audience) environment where different identifiable and hidden needs, ideas, politics, possibilities and states of willingness do coexist.

Infrastructures and beyond

The conceptualisation of virtual realities through the glasses of infrastructures does not as such imply anything practical. Infrastructures become operational, through the reflection of an essential characteristics of an infrastructure to an archaeological VR, namely that the relations between the entities of information (Star and Ruhleder 1994), and especially in the political nature of the mentioned relations (Star 1995).

Documentation of virtual realities as a task of attaching descriptors into entities, is from a scientific point of view rather trivial operation. Intensive work for functional specifications and standards, and research for their premises, usability and use will be definitely needed. As the Semantic Web Activity of W3 Consortium (www.semanticweb.org and www.w3.org/2001/sw) or the compilation of CIDOC Conceptual Reference Model version 1.0 and 2.0, the amount of work not apparent challenges is not to be underestimated. The problem, of what these descriptors ought to be and how they should be structured, persists. However, even when a proper description of semantics and ontology of an archaeological VR data will be ready to use in the future, the resulting formal description is rather obscure from the human perspective even if supplied with a set of productivity tools.[v] From that point of view, discussing relations and usability issues, is rather essential even in this stage.

A notion of the obscureness of documentation data, upon which the argument in this article is largely based on, is by no means a novel one. Kircz (1991b) questions the efficiency of content driven data indexes of which the meta-data schemes are a good example. He suggested that argumentation rather than content driven approach would benefit considerably the efficiency of information seeking tasks. Sillince (1992) broadens the proposal to form an arguer search programme for theoretically every kind of academic articles. The use of rhetoric in non-linear documents is further discussed by Juby (1996) and Carter (2003).[vi]

The problem with the approach presented in the original Kircz model, is its rather mechanistic and mono-disciplinary nature, which restricts its usability in scientific disciplines with different kinds of publishing cultures from the physics. The same has been noted to apply to other discourse-level documentation schemes. Schemes tend to be rather domain-specific which makes them somewhat unsatisfying for more general usage (Teufel et al 1999). Restricting the documentation to a rigid framework of discourse would, even within one discipline, cause difficulties in implementing paradigm changes and new methodologies, not to mention extra-disciplinary references. The Sillince (1992) arguer programme does offer a basis for a functional framework of documenting archaeological virtual realities. The programme requires however some refinement to cover other forms of scientific publishing apart from the article, which is formally rather unlike the virtual realities despite the same communicative aims.

As a contribution to the form issue, Kircz discusses the question of new layout of scientific writing in a somewhat more recent article (Kircz 1998). He argues that as a product of historical evolution, the article could be replaced by a format more suitable for the electronic environment. It is plausible to assume that a scientific publication breaking the traditional form of an article, could have prospects to establish itself especially in hyper-text and in virtual reality environments. The Kircz suggestion (1998) on documents consisting of modules is not without some difficulties related especially to the physics-articles centred structural proposal, and, in the end, the rather conservative approach to breaking the form of a traditional article.[vii] In this regard supplementing the discussion on possible future forms of scientific publication may profit of a contribution offered by the infrastructures theory even in general. For the debate on the use of virtual realities as scientific publications, the link is a rather natural one. Regarding the qualities of infrastructures may be argued, that the theory illustrates rather well the dynamics of

virtual realities. Infrastructures can reflect effectively the aspects that a meaning, not the data matters, the central role of an argument, and the political nature of the structure and the relations.

Welding the argumentational and infrastructural approaches together do present a number of practical difficulties. As recognised by Star (1995) regarding the information structures[viii], every formalised set is in a sense political and therefore a structure presents only a relative truth despite its appearance. Inconsistencies have thus to be not only accepted but also expressed in a meaningful manner. Including the political dimension into a VR seems thus inevitable. As suggested earlier, conceptual models can be used to describe data, describe data about data, and relations between different data elements. In representing politics and inconsistencies though, the formal, or even fuzzy, logic of models tends to be weak. In this sense the Star and Ruhleder (1994) view on infrastructures could provide a plausible functional framework for defining the premises of a documentation scheme, and the argument theory, could complement this with the methods and techniques of expressing the content.

The problem with politics in scientific communication is though persisting despite the acceptance of the politics as an existing reality in the structure of the communication, and in the explicit and implicit interpretations made by the author. The politics should be transparent in a meaning that opinions, their nature and their degree have to be able to be distinguished from each other. This presents two important demands on the practical realisation of the infrastructure: (1) that the practical infrastructures consist of co-existing, interrelating, controversial, conflicting and incomplete structures that still complete each other. (2) Infrastructures have to be able to be evaluated, not by absolute values, but on relative, explicitly political scale that relates itself to relative yet established categories.

Infrastructures of Paths

Making a practical tool out of the infrastructures is far from being a straightforward task. Both the communication of arguments, and the dissemination of the political, are rather non-graphic processes that are difficult to represent in a multi-dimensional environment. Communicating an argument to an audience is according to the classic rhetoric theory, a progressive task consisting of cycles of motivation and presentation. The strategy is still available in a non-linear universe, though not readily exploitable by using conventional methods.

Carter (2003) discusses the aspects of rhetoric functioning in hyper-texts which in their structural alignment resemble virtual realities as already in the beginning. Different tactics of expressing arguments in non-linear documents presented by Carter can be utilised in documenting the virtual realities. An essential difference between the two does though exist. Thinking of the purpose and place of the documentation, in a hyper-text the argument is in the document, and in the virtual reality the argument is built on the document.

Of the argumentative tactics presented in the literature, the Freeman argument analysis model seems to offer the most functional basis for implementation of the VR documentation. (Freeman 1991) Freeman extends argument diagram presented by Toulmin (1958) to cope with larger arguments consisting of a set of sub-arguments. An illustrative visual metaphor of the argument structure could be a path that leads the audience, occasionally not exactly straight but often bending, crossing and uniting with others, and passing through a number of stages to a final conclusion. The path metaphor is drawn as a practical proposition for coding arguments functionality into the virtual realities.

A path is defined in this context as a basically linear structure which guides the audience through the essential entities of the VR. Depending on the level of ontological information attached to the virtual reality document, an

argument path can be constructed as a flat list of references to different relations and data objects in the ontological data (level A). This presupposes however the presence of motivation -type ontologies (because_that, because_of, due_to, derived_from), and support for expressing and tolerating inconsistencies, probabilities and assumptions within the ontology. A less developed variant of argumentation paths (level B) can be accomplished as a list of references to specially written objects containing the sub-arguments. Level C represents the trivial case of an external document with references to the VR describing the argument.

A path is required to possess certain qualities:

- A path is a list of references (nodes) representing sub-arguments, and forming the complete end-argument.
- A node may be descendant of one or more nodes of one or more paths.
- A node may be an ancestor of one or more nodes of one or more paths.
- A node may belong to one or more argument paths.
- To a single virtual reality document may refer unlimited number (including zero) of paths.
- Each path and each node has to have an owner (a person i.e. a scientist) explicitly intellectually responsible for the (sub)-argument.
- Arguments and sub-arguments of different paths may contradict, support or not interfere with each other.
- Sub-arguments within one path may not be contradictory with each other or with the end-argument of the same path.
- The path is supposed to communicate the sub-arguments and the end-arguments. Path becomes invalid in case this requirement is not met.
- In levels B and C the means to describe the arguments and the sub-arguments should not be explicitly restricted to any particular format or media of presentation. Descriptions can be (short) scientific articles, but any other form of scientific communication has to be considered acceptable.

An outline example of a hypothetic argument path could thus resemble the following pseudoformula:

1. TELL node_name call_name_of_the_entity_the_virtual_reality_represents
2. TELL node_name who_formulated_the_argument
3. TELL node_name call_name_or_id_for_the_argument
4. TELL node_name when_the_argument_was_formulated_and_revised
5. TELL node_name sub_argument_1_and_refer_to_motivations
6. TELL node_name sub_argument_2_and_refer_to_motivations
7. ...

Below, as a more practical example, the formula is applied to a argument made on a virtual reality constructed on a Roman republican era anchor:

1. TELL “2" NAME ✎ “La Giraglia wreck anchor” (Marlier, Sabine: La Giraglia, a dolia wreck of the 1st century BC from Corsica,France: study of its hull remains. IJNA (2002) 31.2: 161-171).
2. TELL “3" ARGUMENT_BY “Isto Vatanen <ivatanen@abo.fi>”
3. TELL “4" ARGUMENT_FORMULATED “2003/03/04"
4. TELL “8" ARGUMENT_REVISED “2003/04/16"
5. TELL “6" SUBARGUMENT ✎(reference to four moulded astragals) ✎(reference to those identification to Venus coup) ✎(reference to Marlier 2002, 169)

6. TELL “8" SUBARGUMENT ✎(reference to source 2)
7. TELL “8" SUBARGUMENT ✎(reference to decoration) FOUND_AT ((reference to site location) and (reference to a location information of source 2)
8. TELL “FINAL” ENDARGUMENT ✎(reference to decoration) CARRIES_ATTRIBUTE (likely not uncommon in Roman world) AND CARRIES_ATTRIBUTE (during the late republican times)

The given example is intentionally simplified to illustrate the basic capabilities of the argumentation paths - approach.[ix] With the same basic framework it is possible to refer to considerably more complicated arguments including ones referring to dynamic components in the model, but also more simple argumentation diagrams of the Freeman categories (Freeman 1991).

Conclusions

The question on how to document effectively the genre of documents referred to as “virtual realities”, is not a problem of virtual archaeology own. The demand for efficient management of information stored in similar documents is critical also in a number of other applications. Mutual benefits should and could thus be found in interdisciplinary efforts.

Virtual archaeology has though considerable contributions to offer regarding the general effort on the future of scientific publication, multidimensional documents and virtual realities. The rather unique variety of source data in multiple formats, the temporal span, scientific uncertainties and inconsistencies, and especially rather well established methods for coping these inconsistencies make archaeology an interesting case from the more general point of view.

The proposed method for virtual archaeology documentation has to be considered as an approach. The recent research in documentation and presentation of non-linear information has clearly shown that even though the general aims of the different actors are relatively consistent, the supportive methods for an effective use of information differ considerably. Argument paths intend to contribute on the issue of difficult comprehensibility in the content-based documentation. Further research is definitely needed on descriptors and the data upon which the argument paths are to be built. The most critical question is though the direction to which the usage patterns of the virtual realities are evolving: what for and for what purposes the virtual is used in reality.

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[i] Indicating, not definite survey was conducted by examining a random selection of recent archaeological publications, the BRITARCH-mailing list archives and European Union projects database at Cordis-server (www.cordis.lu).

[ii] The term "virtual archaeology" is used of a discipline working with archaeological virtual realities, in practise mostly visual, but essentially anything digital and virtual in academic sense of the meaning (C.f. Reilly 1991, Forte 1997; Renfrew 1997).

[iii] Few papers and articles (e.g. Barceló 2001, Jablonka et al. 2003) tackle the question, but the general debate and questioning of the "what is being done" has remained almost non-existent.

[iv] The need for broader understanding of the potential position of VR in archaeology does not imply that metadata research is insensible as emphasised already in Vatanen 2003:73-74.

[v] In the sense discussed in this article, is important to note that the on-going semantics and ontology -projects aim to introduce and empower machine-readability of human-readable documents, not to enhance the structure of documents from the human reader point of view.

[vi] The general argumentation theory used in the presented texts is strongly influenced by the New Rhetoric of Burke and Perelman, (see Kircz, Sillince and Juby) and the treatise of Habermas (1994) that sees argumentation as a focus of a society.

[vii] Kircz proposal actually resembles the Carter (2003) tactic 1 of writing hyper-texts with a minimal number of nodes.

viii The question on the relative nature of accuracy of information and interpretations is not a novelty for archaeologists or historians, but is reflected rather poorly in information processing and storage systems. See e.g. Skeates 2000:104-107, Sidiropoulos and Sideris 2003:65 on issues relating to uncertainty in virtual archaeology.

[ix] A small scale Java application framework "VRDocTOOL" has been prepared for practical documentation and consistency tests.