LOCAL VALUES in a NETWORKED DESIGN WORLD

ADDED VALUE OF COMPUTER AIDED ARCHITECTURAL DESIGN

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Editors
Stellingwerff, Martijn Hogeschool voor Wetenschap & Kunst, Sint-Lucas Architecture and TU-Delft, Faculty of Architecture, Form & Media Studies
Verbeke, Johan Hogeschool voor Wetenschap & Kunst, Sint-Lucas Architecture

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AUTHOR
Jaroslaw Szewczyk
Bialystok University of Technology, Faculty of Architecture
Bialystok
POLAND

Abstract

The paper presents the analyses of potential of networked media and computer tools for acting with the digital representations of local cultural values in order to describe and manage architectural cultural heritage. The classification of cultural heritage identifiers is presented, focussing on its applicability to organise digital storage and computer-assisted acting with cultural heritage.

The objective of the paper is to inspire discussion about representing of “cultural identity” of digital data, in emphasize to possibilities of creating more digital tools and methods for management of cultural heritage. It is stated that handling complexity of architectural design should refer to heritage values. Generally, digital representations of architectural objects, similarly to real architecture, must have their cultural identities.

Keywords
Local Values, Cultural Heritage, Cultural Identity, Architectural Context, Architectural Content

1. Background

Engineering software evolve towards unified, multi-platform, multi-application engineering environments, managing not only design geometry but all design information through a building life cycle. Commercial software developers announce terms such as geoengineering, EEM (Engineering Enterprise Management – a term from Bentley Systems), life-cycle management, Product Lifecycle Management (PLM), Building Lifecycle Management (BLM) and Infrastructure Lifecycle Management (ILM; the last two terms from Autodesk, [Day, 2002]), etc. For the last five years commercial vendors have been rapidly developing software according to the ideas described by these terms. As a result the commercial software and networked services supply architects perfectly with tools for long-term management of engineering data, but do not supply
them with any tools for management of cultural context, which is essential when dealing with cultural heritage and local values. This is the reason that in fact many architectural software lack architectural tools, and most architectural notations lack architectural meaning [Szewczyk, 2002].

A lack of tools for management of local values, for acting with aesthetical and cultural information, and for representing “the-worth-of-context”, is unfortunately a typical and common deficiency in commercial graphical software and CAD. This seems to be strange enough, because CAD systems and other tools for graphics have been regularly used for many years by historians, archaeologists and many professionals dealing with cultural values. For instance archaeologists, who haven’t proper tools for management of cultural values, often try to work in AutoCAD and to imply a very complicated layer structures which pretend to substitute the non-existing representations of local values, context information and other “cultural data”. For example in 1993 Harrison Eiteljorg, the Director of the Center for the Study of Architecture/Archaeology (CSA), worked out the AutoCAD model of the older Athenian propylon containing data defined by 153 drawing layers and by the three DBF files. These digital representations of the archaeological remains were segmented according to date, material, and a variety of other criteria [Eiteljorg, 2000]. Unfortunately, 153 layers seemed to be far too small for representing cultural data. After that, Mr. Eiteljorg has developed an extended CSA Layer Naming Convention [Eiteljorg, 2002], which enable users to define over 1200.000.000 abstract layers, each containing archaeological data and named separately (for example as follows: 2002NT10045_PTPCWFXA-0489-0478). CSA Layer Naming Convention was regarded as the best, the most flexible and exhaustive notation of data containing archaeological meaning, and in some way similar to data representing architectural meaning, containing cultural values also. But this example implies the question: Can the 1200.000.000 abstract layers named 2002NT10045_PTPCWFXA-0489-0478 satisfy us?

2. The Statement:

2.1. Local values build the global cultural heritage and they generate the worth of architecture

2.2. Architectural software and networked services do not supply architect with tools for representing and management of local values.

2.3. Digital representations of architectural objects, in opposite to real architecture, have not their cultural identities

The problem of digital representations of local values is essential when redesigning existing spatial artefacts (buildings, urban areas). As it was noticed by a vendor of commercial CAD software, “80% of architectural work in Europe is done on old buildings. This is undoubtedly also the case in any country with an architectural heritage of buildings made of stone or other durable material, of equal or greater importance than any new construction work” (www.interstudio.net/InterstudioNewsE.html#crazyparameters).
3. The Values

In the past there were a few attempts to identify local values in order to enable digital storage of cultural identifiers. Maver and Petric [1999] suggested the term Virtual Heritage (VH) when reporting the usage of VR systems for digital restoring the cultural heritage. Torre and Mason [2002] focus on identifying, articulating, and establishing cultural significance, defining the last term as “importance of a site as determined by the aggregate of values attributed to it”, claiming that these values “should include those held by experts – the art historians, archaeologists, architects, and others – as well as other values brought forth by new stakeholders or constituents, such as social and economic values. (...) Value can be defined simply as a set of positive characteristics or qualities perceived in cultural objects or sites”. ICOMOS Burra Charter [1999] defines cultural significance as “aesthetic, historic, scientific, social or spiritual value for past, present or future generations”, synonymous with heritage significance and cultural heritage value. It claims that the adjectives aesthetic, historic, scientific and social, are not mutually exclusive and encompass all other values.

Mason [2002] argues for a deliberate, systematic, and transparent process of analysing and assessing all the values of heritage, and he is against determining its signification on the basis of a too limited number of established criteria. For this reason Mason [2002] appreciates more extended typologies of heritage values, that “would move conservation stakeholders closer to having a lingua franca in which all parties’ values can be expressed and discussed.” He follows English Heritage document [1997] and suggests a detailed classification of heritage values, as follows:

3.1. Sociocultural Values:

a. Historical values, which can accrue from the heritage material’s age, from its association with people or events, from its rarity, uniqueness, from its technological qualities, from its archival or documentary potential. They can be divided into two subgroups:
   i. educational/academic values of heritage, resulting from the potential to gain knowledge about the past;
   ii. artistic-historical values based on an object’s being unique, being the best, being a good example of, being the work of a particular individual;

b. Cultural/symbolic values:
   i. political values: the use of heritage to build or sustain civil relations, governmental legitimacy, protest, or ideological causes;
   ii. craft- or work-related values, relating to the process of making and building, often used to stimulate ethnic-group identity on basis of the uniqueness of their craft;

c. Social values, including “place attachment” aspects of heritage value, and the use of a site for social gatherings such as celebrations, markets, picnics, or ball games – focusing on the public-space and shared-space qualities;

d. Spiritual/religious values can emanate from the beliefs and teachings of organized religion;

e. Aesthetic values, i.e. visual criteria for labelling things and places as heritage valuables for the sensory experiences.
3.2. Economic Values overlap socio-cultural values, and they are distinguished when they can be measured by economic analyses:

- **Use Values (Market Values)**, to which a price can be assigned easily, refer to the goods and services that are tradable and priceable in existing markets;
- **Non-use Values (Non-market Values)** are not traded in or captured by markets and are therefore difficult to express in terms of price; and they can be broken down into the categories:
  - *existence values*, i.e. resulting for its mere existence;
  - *option values* refer to someone’s wish to preserve the possibility to consume the heritage’s services at some future time;
  - *bequest values* stem from the wish to bequeath a heritage asset to future generations;

3.1. Ecological Values stem from the role, that a heritage site may play in constituting or sustaining a natural ecosystem.

We can add to it (following [Heritage Asset Management Guideline]) the fourth category, SCIENTIFIC AND ARCHAEOLOGICAL VALUES, derived from the scientific potential of the assets. We can also try to add a few sub-categories mentioned by Mason, but not classified (*newness values, informational values, prestige, recreational or monetary values*).

Other classifications of heritage values have been made by Reigl [1982], Lipe [1984] and Frey [1997], and presented in official documents, such as [Heritage Asset Management Guideline] and ICOMOS Burra Charter. A few interesting remarks and concepts can be considered, following “Appendix E: Checklist of data for asset register” in the paper by Liguori et al. [2001].

4. The Thesis

4.1. Handling complexity of architectural design should allow for handling heritage values

4.2. Architectural software and networked services need to be developed in order to supply architect with tools for representing and control of cultural heritage in architecture, and it will be possible only if the applications can intuitively act with cultural values. This implies the necessity for “context-friendly” architectural tools, enabling user to digitally store both local and global values, as well as digital representations of their local, cultural contexts.

4.3. Generally, digital representations of architectural objects, similarly to real architecture, must have their cultural identities.

Torre and Mason [1995] claim that “value has always been the reason underlying heritage conservation. (…) no society makes an effort to conserve what it does not value.” But the question is: How to represent such values digitally and how to implement them into any real CAAD software?

The above mentioned classification of heritage values (after [Mason, 2002] and [Heritage Asset Management Guideline, 2001]), which was defined as a set of positive characteristics or qualities perceived in cultural objects or sites [Torre and Mason, 2002],
provides a base for defining a set of unique digital identifiers representing heritage values digitally. But, for achieving this goal, the hierarchy of values needs to be redefined, in order to establish final computer-optimised set of digital identifiers, organised not according to sociologists’ point of view, but according to real needs expressed by architects and other CAAD users. For example, a general divergences between spatial and non-spatial, local and global values seem to be natural for architects. Other classification factors are also possible, if they organise values and put them in order. The resulted prearranged classification should organise values hierarchically, allowing to match sets of programmable digital identifiers to them.

Mapping values (represented by their digital identifiers) to elements of an architectural project seems to be the most natural consecutive action after they were restructured. We believe that intrinsic nature of cultural values implies needs for more flexible approach, so that digital identifiers should be precisely, but dynamically mapped to any elements of an architectural project (i.e. to CAD objects, text units, raster images etc.) rather, than they could be too limited and fixed to match graphical elements only in a predefined way. Besides, we should not establish too limited sets of identifiers of values after they were understood too narrowly, leaving their context, nor we cannot reduce these identifiers to a small set of simple parameters. A well-defined, multi-layered, hyper-structured hierarchy of them, pretending context, has to be appreciated instead.

We can categorise heritage input data in order to enable effective collecting all attainable information relevant to the assessment of cultural significance. For that reason we can try to develop ICOMOS Burra Charter [1999] idea, that such information concerns:

(a) the developmental sequence of the place and its relationship to the surviving fabric;
(b) the existence and nature of lost or obliterated fabric;
(c) the rarity and/or technical interest of all or any part of the place;
(d) the functions of the place and its parts;
(e) the relationship of the place and its parts with its setting;
(f) the cultural influences which have affected the form and fabric of the place;
(g) the significance of the place to people who use or have used the place;
(h) the historical content of the place;
(i) the scientific or research potential of the place;
(j) the relationship of the place to other places;
(k) any other factor relevant to an understanding of the place.

Summarising, ICOMOS Burra Charter emphasises that “cultural significance is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects.”

Classifying, organising and mapping heritage values, represented by digital identifiers, might be a preliminary stage for further development methods and tools for advanced computer-assisted storage and maintaining of cultural heritage data.

The second challenge is to provide intuitive, visual access to these data. This implies the necessity for “context-friendly” architectural tools, extracting and showing heritage data when user ask for them (querying or browsing model with option of heritage access), or displaying them automatically when browsing context. These tools and technologies are still to be developed.
5. Opinions and Examples

CAD tools have been playing a secondary role in representing heritage values until now. Many researches do not perceive CAD as an appropriate technology for managing such information. For example Bonfigli [2001] suggests a distributed architecture to access cultural information in the Web environment regardless of its CAD representations. She notices:

“Cultural heritage information available through the Internet includes mainly multimedia data like written texts, images, video and audio files that describe art works in permanent collections and temporary exhibitions (…). Moreover the advent of virtual reality Web technologies (like Quick Time VR and VRML) enables the user not only to access multimedia data, but also to visualize and interact with 3D objects reproducing art works, galleries, museums, churches and other cultural monuments and to do virtual walkthroughs. This can be considered very interesting in order to visualize sculptures, buildings, and archaeological finds in which concepts like real volume and interactivity with the user are very important.”

Many researchers underestimate CAD technology, but does not miss it at all. Here is an example [Veltman, 1997]:

“A project at the Museum for the History of Science in Florence (…) takes the notebooks of Leonardo da Vinci as a point of departure. Scientific devices in these notebooks are linked with images of physical models of these devices, films of these models in action, Computer Aided Design reconstructions of these models showing them in context. For example, a crane by Brunelleschi recorded by Leonardo in his Codice Atlantico is shown in action on a reconstruction of Brunelleschi’s dome of the cathedral in Florence. This device is further linked to bibliographical references. Hence the electronic archive on this device (…) entails reconstructions and literature which put it into context.” But, even researchers, who underestimate the role of CAD in representing heritage values, recognise the future potential of advanced CAD technologies, such as object technology. Veltman [1997] continues:

“(…) technology can be used with very different consequences if one extends the concept of foundation classes to include cultural and historical dimensions. If this occurred, an architect in Nepal wishing to build a door, in addition to the universal principles of construction applying to such objects, would be informed about the particular characteristics of Nepalese doors, perhaps even of the distinctions between doors in Kathmandu or near Annapurna. (…) All this may seem exaggerated. But after some of the key historical houses with elaborate ornamental carvings in Hildesheim were bombed during the second world war, a small group of carpenters worked for several decades to reconstruct the original beam by beam, carving by carving. They did so on the basis of detailed records (photographs, drawings etc.).”

Here is another similar opinion: “Reconstruction is not a recent science, but the CAD applications do offer nowadays an easier possibility of recreating damaged, transformed or disappeared sites. In fields such as archaeology, history and architecture those technologies are of particular importance” [Cultural Heritage, 2003]
6. Discussion

As the subject of representing cultural identity of the digital data covers many topic areas, the discussion can consider many issues. Here we focus on three issues:

6.1. The present usage of software tools in explorative design, architectural science and reconstitution of heritage assets

The lack of architectural tools for representing “cultural identity” compels architects to use non-architectural tools in their work. Architects and scientists act with architectural information using modelling software, VR environments and GIS systems (for example VR-GIS for urban analyses). For instance Maver and Petric [1999] reports the usage of VR systems for digital restoring the cultural heritage. The author’s search for the examples of software usage that had been presented in literature has led to the conclusion, that many more researchers investigate usage of GIS and visualisation software rather than CAD for gathering heritage information (for instance Boehler et al [2001]).

On the other hand, generic architectural systems have surprisingly limited usage and they are perceived as a robots for generating standard documentation of standard architectural models. The relatively small, but interested group of applications is software for early stage design, but the most popular pieces of software (Autodesk Architectural Studio, D-Board from Nemetschek and SketchUp from @Last Software), found as architectural software, do not carry architectural data at all! This applications are in fact conceptual solid modellers only (Architectural Studio, SketchUp) or digital sketching boards (D-Board, Architectural Studio), but they are not oriented towards “cultural identity of data” nor even “architectural identity of data”.

Perhaps the most interesting software from architect’s point of view seems to be archaeological software, developed in order to represent chosen cultural values. An example is ArchEd Program – a tool for drawing Harris matrices which are used in archaeology. Harris matrices are defined as “a new type of calendar”, allowing archaeologists to see the stratigraphic sequences of complex sites in a diagram, i.e. they represent relative time parameters of complex graphical data, converting data to a simple diagram [The Harris Matrix, 2003]. We can perceive Harris matrices as computational methods for representing time aspect of historical values:

“Archaeological stratigraphy was systematized in the early 70’s by E. Harris when he was confronted with an extremely complex excavation in Winchester. Harris describes layers as the smallest units of archaeological identification. Beside their spatial dimensions, these layers also have a time dimension. As a result he developed the so-called "Harris-Matrix" to describe the time relationships between layers” [Principles…, 1998].

The example of Harris matrixes for describing time aspect of historical values implies the idea of similar tools and methods for describing other values, yet such tools and methods have not been developed until now.
6.2. Heritage – sensitive architectural notations

The investigation of digital notations of architectural data, performed by Szewczyk [2002], has shown that nowadays the existing data sets are too complex, difficult to deal with, they are often inconsistent and in result they are not really oriented towards architecture. In results architects are forced to work with semi-architectural notations, lacking their essence, i.e. lacking methods to describe elements of cultural heritage connected to geometry forms. Instead of language of architecture they deal with virtual cost-working slang. The IFC classes can be a good example, because of their architectural origin. In spite of the fact that IFC classes pretend to be architectural notation for architectural software, only a part of the these classes is dedicated strictly to architects, so IFCs lack consistency in defining architectural databases.

Veltman [1997] writes about other possible richer data notations:

“From the above it will be clear that the computer revolution is about much more than simply recording existing objects. It entails reconstructing objects which no longer exist and to some extent exploring hypotheses concerning objects which are thought to have existed. How will we navigate through all this added information? Some believe that simple traditional lists will be sufficient, or that there will be new combinations of such lists. Nortel's Helmsman software includes features as Boolean searches and depluralization. Some assume that the geographical metaphor will be enough, that maps will help us find everything that we need. Others are exploring the use of spatial metaphors to arrange concepts. The visible language group at MIT foresees the use of geographical maps and Cartesian co-ordinates for basic orientation, which would then be combined with different typefaces. More important concepts would be in bold script and use different typefaces. Both Xerox Parc and the GMD have been exploring the potentials of three-dimensional spatial arrangements in the form of cone trees. Some favour a temporal metaphor, proposing that everything be organized in terms of time. A number of persons are exploring cubes as a means of integrating time and space. The n-Power project (Toronto) is a simple example. Dr. Benking (Ulm) has a more complex version which relates three cubes to Sir Karl Popper's notion of the three worlds (subject, object, meaning), and foresees using perspective as a means of navigation.”

Unfortunately, these concepts are developed regardless of CAD and they do not fit into architects’ expectations. However, they can potentially serve as a source of inspiration for the future investigation into the matter of richer, CAD-based notations of architectural, heritage-sensitive data.

6.3. The role of networked engineering services

The network enlarges CAD environments with possibilities of distributing data, sharing knowledge, communicating and co-working at the same time with the same data. Shared architectural data, distributed via the network and containing cultural values, must be composed very clearly in order to showing explicitly their unique cultural identity. The existing architectural notations are not optimised towards fulfilling these needs.

Networked services have been developed in order to act with a great variety of engineering data, such as: CAD models (project sharing via the Web), 3D streamed models (streaming software, VR networked environments), drawings (publishing services applying DWF format and raster files; portfolios), live views (services called “Web camera”, teleconferencing), etc. [Szewczyk, 2001]. Some educational Web portals enlarges these above-mentioned tools, adding to the common sets of networked
equipment some new ones. The new services often act with cultural data and represent the local identity of pieces of data [Maver and Petric 1999]. Finally, networked engineering services are developed dynamically, but they follow commercial needs and do not play a noticeable role in CAD-based heritage management and acting with cultural data accompanying with CAD models. The inability of networked media to supply such activities results from analogous inability of CAD tools to supply them. However, networked technology seems to be potentially the best medium to present national, regional or local activities with emphasis on preventing cultural heritage. Such activities are regularly performed using multimedia technology and they usually do not make use of CAD.

7. Findings and Conclusions

7.1. The investigation shows the needs for supplying architects with the tools for management of cultural values.
7.2. Notations of CAD data must include “cultural information”, such as local values, local context, etc. in order to safeguarding of the cultural identity of the digital data
7.3. Research for protection, conservation and enhancement of cultural heritage must include development of “context-friendly” digital tools.
7.3. Networked technology seems to be potentially the best medium to present national, regional or local activities with emphasis on preventing cultural heritage.
7.5. Analysis of the present state of the research and to the base for future activities showed that the place of computer technology in cultural heritage research still needs to be explored.
7.6. Tools and methodologies for the architectural heritage management can be applied to some other disciplines based on cultural heritage data. Archaeology seems to be the one of them.

8. Appendix: The Significance of the Problem According to European Commission

European Commission has a budget of 3 600 millions EUR for one of the seven thematic priorities of the 6th Framework Programme, i.e. for a priority called “Information Society Technologies”. This priority includes applied IST research addressing major societal challenges: “for cultural heritage - intelligent systems for dynamic access to and preservation of tangible and intangible cultural and scientific resources” [Miles, 2002]. “The focus is on ‘ambient intelligence’ (…) for the preservation of cultural heritage” [Priority Thematic Areas of Research in FP6, 2002, p.7]. The above citations shows the significance of the problem according to European Commission. The next following citations verify and confirm the importance of the computer-aided preservation of cultural heritage, and suggest few ways of achieving that goal:
“The objective is to develop technologies for harnessing computing and storage resources which are distributed in geographically dispersed locations, and for making them accessible, in a seamless way, for complex problem solving in science, industry, business and society” [Priority Thematic Areas of Research in FP6, 2002, p.8]
“Knowledge technologies and digital content: The objective is to provide automated
solutions for creating and organising virtual knowledge spaces (e.g. collective memories) so as to stimulate radically new content and media services and applications” [Priority Thematic Areas of Research in FP6, 2002, p.10]

“Work will focus on technologies to support the process of acquiring and modelling, navigating and retrieving, representing and visualising, interpreting and sharing knowledge. These functions will be integrated in new semantic-based and context-aware systems including cognitive and agent-based tools. Work will address extensible knowledge resources and ontologies so as to facilitate service interoperability and enable next-generation semantic-web applications. Research will also address technologies to support the design, creation, management and publishing of multimedia content, across fixed and mobile networks and devices, with the ability to self-adapt to user expectations” [Priority Thematic Areas of Research in FP6, 2002].

We can criticise this approach, because it concentrates on knowledge management technologies with emphasis on multimedia content, and ignores other fields such as interoperability with sets of CAD data, implementation of existing CAD and PDM tools, etc. But, on the other hand, this specific approach, which is suggested to be developed and funded by UE Commission, can stimulate advances in the field of digital representation of local values. Besides, it illustrates the significance of the problem, still being to be solved.

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References


Figure 1 and 2. Examples of “local”, architectural graphical data, collected by Bialystok Polytechnic (photos were intentionally merged and unordered).