



HAL
open science

Exploiting the architectural heritage's documentation: a case study on data analysis and visualisation

Jean-Yves Blaise, Iwona Dudek, Pascal Bénistant

► To cite this version:

Jean-Yves Blaise, Iwona Dudek, Pascal Bénistant. Exploiting the architectural heritage's documentation: a case study on data analysis and visualisation. I-Know 03, Conference on Knowledge Management, Jul 2003, Graz, Austria. pp.128-134. <halshs-00266658>

HAL Id: halshs-00266658

<https://shs.hal.science/halshs-00266658v1>

Submitted on 11 Apr 2025

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



HAL Authorization

Exploiting the Architectural Heritage's Documentation: A Case Study on Data Analysis And Visualisation

Iwona Dudek , Jean-Yves Blaise, Pascal Bénistant
(UMR CNRS/MCC 694 MAP, France
idu(jyb)(pbe)@gamsau.archi.fr)

Abstract:

Documentation analysis and organisation are vital to the researcher when trying to understand the evolution of patrimonial edifices and sites. Documentary sources provide partial evidences from which the researcher will infer possible scenarios on how an edifice may have changed throughout the centuries. Still, in the field of the architectural heritage, there is a gap to fill between proven data management technologies that provide solutions for documentation handling, and geometric modelling techniques that underlie reconstruction efforts.

Documentation is organised with regards to what the documents are, books, illustrations, etc... Virtual renderings feature a geometry that bears no link to the documentation's analysis. Our contribution introduces a solution for attaching the documentation to architectural concepts that represent physical beings used in the edifice's structure, and this without modifications on existing documentation descriptions. 3D scenes can then be used as one of the means to access or visualise *the information* we hold on the edifice's or site's evolution.

Key Words: Architectural heritage, Object Persistence, Interfaces, Information visualisation, Web databases.

Categories: H.3.3 [Information Search and Retrieval] Information filtering
H.5.2 [Information interfaces and presentation] user Interfaces

1. Introduction and Related Works

Preservation of the architectural and urban heritage includes of course a concern for the edifice itself, but it also includes a concern for the edifice's documentation. This documentation helps the researcher to try and state for instance how the edifice evolved through time or how the edifice was when nothing is left of it today. It provides *clues* that will need an *interpretation* from the researcher or conservator in order to *understand* the edifice or site's evolutions. In this process, the step of data interpretation is a critical one. What are the solutions one can base on in order to organise a documentation with regards to an architectural analysis of its content?

Numerous experiments, mainly in the field of archaeology, have been carried out using the paradigms of GIS (see for example [Ioannidis 1999]). But in the case of architecture at its various scales, geometry cannot be considered as a relevant intermediate between the documentation and the edifice. In parallel, realistic 3D models prove relevant with respect to communication goals, see for instance [Burton 1997]. But communication through such renderings does not serve the understanding of the edifice since [Kantner (2000)]. We develop an approach in which what is "beyond" the image is more important than the image itself, in line with contribution like [Stenvert (1991)] or [Alkhoven (1993)].

We observe that although the edifice is not the information, the information is relative to the edifice. This means that at least a quotation link exists between them. Our contribution investigates use of the physical elements of architecture as filters on the set of data architects, conservators or archaeologists handle. In this paper we will focus on the methodology we develop for supporting the step of *data interpretation* that conservators, architects, archaeologist face when they critically examine the data collections they handle [Łukacz 1998].

2. What We Need to Visualise

The methodology used by historians of architecture and conservators in order to analyse evolutions of an architectural object is based on the interpretation and comparison of various types of documentation, as stated in the [Cracow 2000] charter. Therefore the idea that different pieces of documentation are in relation to architectural elements (a building, a portal, etc.), is for them a natural (although often unspoken) part of their work methodology. One key goal of our research is to capture, capitalise and visualise the actual basis of this methodology – relations between an architectural artefact and the wide range of documents that refer to it. When studying the historical evolutions of an edifice one should analyse and compare various historical documents, investigate comparative studies and analysis conducted by different authors. Such a documentation is obviously heterogeneous. For us, each piece of documentation that may potentially have an influence on the course of the analysis and therefore an effect on the final hypothesis, is interconnected with the physical artifacts. Our experiences are focused on historical edifices located in Kraków (Poland). We reference various historical documents connected to the urban fabric of Kraków's Old Town and problems related to history of architecture and conservation. In line with [Stenvert (1991)], documents are described in two ways:

- *standard data identification* describing what the document is (author, edition, type of media, technique, etc..) as used by the libraries, museums, etc.
- *interpretation of data-content* (morphology typology, etc.), used especially in art and architectural historical studies.

The documentation that we describe is stored in various collections (libraries, museums, archives, ...). We propose a (web-based) distributed architecture in which we only refer to pieces of information that are detained by various institutions. We do not deliver digitised copies of documents, but *localise* them in terms of :

- In which library(ies) can they be found?
- To which architectural objects do they refer?

2.1 Data Analysis and Interpretation

In order to interface pieces of information on the edifice, we propose to use its morphology as a support for data retrieval and documentation visualisation. Consequently, we need to isolate relevant architectural concepts (or shapes) and build out of them 3D models, as developed in [Dudek 2001]. But we have shown that the documentation that serves as source of evidences is far from being exhaustive and non-ambiguous. What is more it is not structured with regards to the edifices or sites

that it documents. We will therefore face several difficulties when wanting to implement a link between a document and an architectural object: visualise shapes that in all cases are hypothetical, visualise precision and relevance of the available documentation, documented each concept individually, produce representations that features architectural elements located in the space of the city at a given period of time, etc.

In other words, we face the challenge to mark the 3D objects present in scenes with graphical codes that will help the user read and understand the interpretation step that gave birth to them¹.

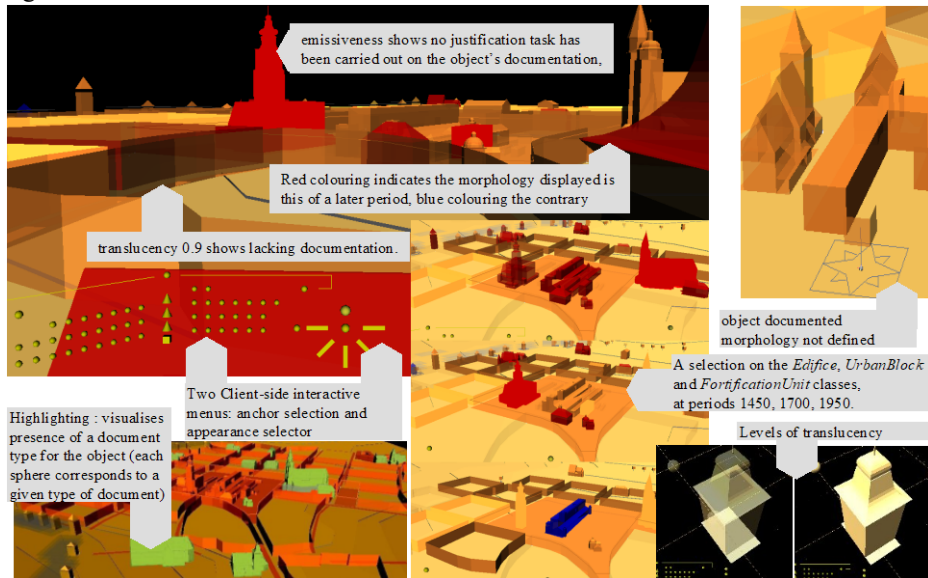


Figure 1 : *Various graphical markings used to visualise the data interpretation step*

At this stage of the paper it is necessary to stress that our contribution is above all a methodological one. Actual implementation will be discussed in the following paragraphs, but the core of our proposal, and its contribution to the state of the art in our application field, is to be found in this methodological framework:

1. Identify and organise theoretical architectural concepts.
2. Include in their description a support for the evaluation of the documentation.
3. Document instances of the theoretical model in relation to documentary sources.
4. Provide an interpretative representation of their morphology inside 3D scenes
5. Connect them to the documentary sources
6. Provide a visual marking of their hypothetical nature
7. Develop formalism to mark the transformations during their history
8. Provide means to analyse and study 3D scenes that show the status of documentary sources on each 3D object (each instance).

[1] Scenes are given four roles: represent an interpretation of the architectural morphology, visualise each object's documentation's analysis through a graphical marking, retrieve information on any object in the scene and visualise, as a 3D scene, the result of a query on the documentary sources.

Some of these aspects are illustrated in the figures below, and although we will not detail each of them, the major steps are commented in the following paragraphs.

3. An Architectural Model: Root For Documentation Anchoring

The concepts we use as a mean to visualise information are identified through an analysis of the morphological, structural and functional differences and similarities between the objects. Once this is done, we classify the concepts using the principle of heritage of properties. More detailed description of this identification methodology can be found in publications related to the ARKIW program [Dudek 2001], [Blaise 2002]. Each concept is formalised in a class that contains six blocks of information. The *Morphology block* detains the information relative to the concept's geometrical features, it serves as the main division line inside the model. Documentation, Typology and Evolution information blocks are used in order to attach to each instance a set of qualifying attributes that are used in order to monitor the actual appearance of the object. The *Documentation block* is responsible for the handling of queries on the database that references the documentation. The *Typology and Evolution blocks* store an evaluation of the documentation that will be carried inside the 3D scene, letting us for instance to visualise with different colour codes edifices for which we have different pieces of documentation. Instances are stored in an RDBMS context (MySQL) as well as in XML sheets.

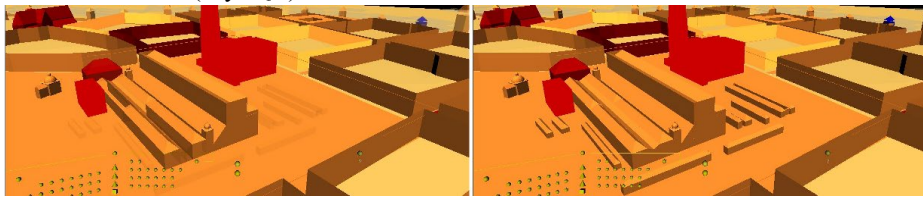


Figure 2 : Left, *uncertainty on the object's dating, signified by translucency.*

Once concepts are identified, organised and formalised, the making of 3D scenes results in the instantiation of the model's theoretical shapes. Scenes feature instances of the model and the current state of their properties, among which the justification attributes. An indication of the documentation's analysis (levels of certainty, type of documentation, typologies, etc.) can thereby be displayed natively or interactively inside the VRML scene.

3D scenes are used as a query mode by selecting an object inside the 3D model. They can also be used as a visualisation of the query's result, by instancing the objects corresponding to the search and calling their VRML representation method. Scenes are calculated online with this process: selection of objects, parsing and re instantiation of the instances through Perl XML::SimpleObject Module [Hampton 2001], calculation of their VRML representation (scene appending, Perl Classes).

The pluses, minuses and possible applications of the VRML standard for architectural modelling have often been discussed, see for instance [Oxman 1999]. Our scenes are written in VRML 2.0 both for Cosmo and Cortona plug-ins. We stress the need to create scenes that would remain autonomous from the application that created them. By saying this, we rejected the possibility of investigating JAVA/VRML solutions

that various experiences such as [Landes 1988] have proven efficient, but that seem to us too exposed to versioning problems.

4. Visualisation Issues

We believe that a scene's appearance should underline the problems it raises, and not hide them behind the curtain of the morphological exhaustiveness renderings tend to impose. If the knowledge about the elements that we represent is incomplete we should be able to make it visible in the scene. This question is not very widely addressed in the field of architecture, although contribution of [Alkhoven (1993)] can be quoted. Our contribution introduces some proposition for uncertainty handling.

Among the properties nested inside each architectural concept we include what we called justifiers. Each object contains a group of such attributes that are responsible for displaying the object with relevant graphical codes. They are supposed to make visible inside a 3D scene the semantics associated to the source's analysis. For example the user can demand a visualisation of the level of certitude on an object's dating (represented in this example by a level of translucency). What is more, objects inside the 3D scene should be diversely represented with regards to two questions:

- Is the object documented, and is this documentation analysed?
- Is the morphology known, and if not is a morphology for this same object but at a different historical period available?

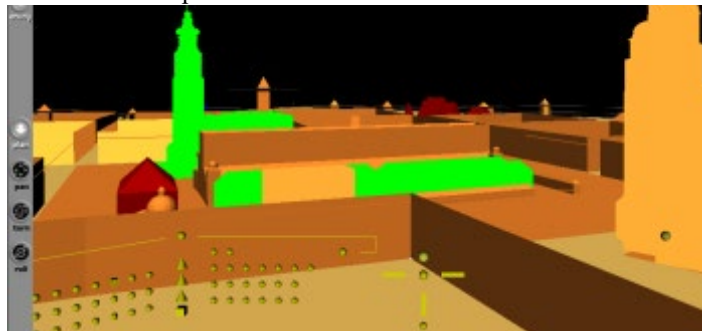


Figure 3: *A visualisation of the Market square, transparencies toggle off, highlighting of edifices with a documentation that includes hypothetical plans, object controls opened (on left, Highlighting buttons and cones, in the center, anchor selection i.e choice of database to query).*

In order to provide graphical markings that would visualise the answers to those two questions we have defined inside each concept alternative representation methods. If for instance the object is documented and localised but has not yet been given a morphology we will represent it by a symbol in the scene. This symbol's actual appearance will depend on the object's class. If on the contrary the object has been given a morphology but its documentation has not yet been thoroughly analysed we will represent it with VRML's emissiveColor property (node Material) turned on. Moreover, several client-side interaction disposals are nested inside the scenes for object control (highlighting buttons used in order to visualise presence or not of each type of documentation, selection of database to query, etc...) or for scene control.

5. Conclusion

In the field of architectural conservation, documentation and representation play essential roles in the understanding of the edifice and of its evolutions. Documentation provides evidences for an analysis of the edifice's morphological evolution. 3D helps evaluating hypothesis on morphological evolutions. Moreover, 3D representations can help in visualising the documentation by providing a visual interpretation of the documentation's content.

Our proposal introduces a methodological approach, and investigates a possible technological solution, for an enhanced link between physical objects and what documents them: raw documentary sources. It provides an operational framework for the capitalisation (through database and XML formalisms) of this *interpretation phase* during which researchers establish meanings of raw data, and that derives from the reading of sources possible scenarios of morphological evolutions. Although the documentation analysis step is a costly one, it is in our application a vital one, and it can greatly benefit from the memorisation we have tried to provide tools for.

Acknowledgement

Our experiences are carried out in the framework of PICS and APN research programmes (CNRS / KBN, CNRS).

References

- [Ioannidis 1999] Ioannidis C., Chlepa H.: "Spatial information system for the geometric documentation and restoration studies of monuments: an application to the wall of ancient Messene"; Proc. ISPRS WG V/5 Workshop Thessaloniki, Greece, (1999).
- [Burton 1997] Burton R.: "M.E Hitchen, P.G Bryan, Virtual Stonehenge: a fall from disgrace?"; Proc. CAA 97, Birmingham (1997)
- [Dudek 2001] Dudek I., Blaise J.Y.: "Interpretative modelling as a tool in the investigation of the architectural heritage: information and visualisation issues", Proc VIIP, Marbella (2001)
- [Kantner (2000)] J.: "Realism vs Reality: creating virtual reconstructions of prehistoric architecture", in "Virtual reality in archaeology"; Archeopress/ Oxford (2000)
- [Stenvert (1991)] Stenvert R.: "Constructing the past: computer-assisted Architectural-Historical Research"; University of Utrecht/ Utrecht (1991)
- [Alkhoven (1993)] Alkhoven P.: "The changing image of the city"; University of Utrecht/ Utrecht (1993)
- [Blaise 2002] Blaise J.Y., Dudek I.: "3D models as visual interfaces for documenting the architectural heritage: the defensive system of Cracow"; Proc VIIP, Malaga (2002), 48-53.
- [Łukacz 1998] Łukacz M.: "Metrologia i pierwsza faza zabudowany starożytnych bloków lokacyjnego Krakowa", Proc. Int. Conf. on Conservation, Kraków (1998), 92-100.
- [Landes 1988] Landes S.: "Design and implementation of a web-based 3D campus Information System for the University of Karlsruhe"; Proc. COBRA 1998, Florianopolis (1988)
- [Whiting 1997] Whiting D., Nickerson S.: "Computer aided recording tools automate the creation of a site information system"; Proc. CIPA 1997, Göteborg (1997), 121-130.
- [Cracow 2000] "Cracow Charter 2000", signed by representatives of conservation institutions; Proc Int. Conf on Conservation Krakow 2000, Krakow (2000), 191-193.
- [Hampton 2001] Hampton K.: "The Perl XML Interfaces"; O'Reilly on XML.com (2001)
- [Oxman 1999] Oxman R.: "Visual Emergence in creative collaboration"; Proc. 17th eCAADe Conf., Liverpool, (1999), 357-363.