



Structural approach to restoration and conservation of Moroccan Kasbahs, using multimedia and oracle based ontology: the case of Kasbah des Caid in Tamnougalt, Morocco

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Abstract

The original purpose of Kasbahs has changed over centuries. Mostly built as protective castles at the trade routes, many Kasbahs were converted and are meanwhile partly completely desolate. The prevention of Kasbahs is only suitable with an economic restoration concept and an efficient application. This often means the adaption of the unique character of these earth buildings to nowadays requirements. Because of the complexity and the size of the Kasbahs with its various different historical utilization concepts, an efficient planning is necessary. An Ontology based on Oracle is a suitable way for the investigation, documentation and restoration, resting on a master plan. The contribution presents the multiversal facets of the information management during the restoration process of Kasbah Tamnougalt and the basis of this ontology of a long-term master plan.

Keywords: restoration, kasbah, database, monument preservation, ontology, CIDOC/CRM, information, Morocco

1. Introduction

The original purpose of Moroccan Kasbahs has changed over centuries. Mostly built as protective castles at the trade routes, many Kasbahs were converted and are meanwhile partly completely desolate. The prevention of Kasbahs is only suitable with an economic restoration concept and an efficient application. This often means the adaption of the unique character of these earth buildings to nowadays requirements.

This structural approach to restoration and conservation of Moroccan Kasbahs should be exemplified by reference to the probably oldest Kasbah of Morocco in Tamnougalt, a small village in the Draa valley, strategically positioned on the trading route between Timbuktu and Marrakech. Within a first student workshop in February 2015, several important documentations of the Kasbah and the directly flanking, already in certain areas collapsed Ksar were conducted, partially with the assistance of modern UAV (unmanned aerial vehicle) technology with the support of two colleagues from the Geodesy from the University of Rostock. The precise, three-dimensional acquisition of the Kasbah complex is the basis for the elaboration of a profound restructuring concept, elaborated at the University of Wismar in cooperation with the Centre of Conservation and Rehabilitation of Architectural Heritage of Atlasic and Subatlasic Zones (CERKAS).

The difference between 'wild activism' and a methodical approach in the interest of the reconstruction, restoration, preservation or the reutilization of buildings is often the structured approach and the contextualization of information. In former times information was exchanged in meetings or in a laborious handwritten way. Today we have databases for this purpose, in which all existing and continuously new information and findings can be implemented. From these you can create excerpts and allow purposeful inspections from different locations. Databases are so to speak not only the basis of a master plan, but also allow the effective realization and control of it.

Today one can often do not preserve everything that is worth preserving. This applies in particular to Morocco with its various architecturally special, worthy of preservation, but often rotten earthbuildings. Frequently the conservation status is too bad. A demolition of desolate parts of the building offers the chance and sometimes is also a condition to a more efficient and concentrated focus on the better preserved part. This has as well something to do with the efficient use of financial, material and human resources.

Moreover, the reutilization is nowadays often the only chance to preserve and maintain historic structure. But it usually comes along with the partial destruction of the historic structure, for example when modern sanitary installations are integrated. Also the concerns of the public sector, for example in road and canal construction, may lead to building structural changes. With this structural adaptation to today's requirements and thus accompanied destruction, is without a structured approach and contextualizing of information always an immaterial destruction to be stated.

Without prospecting the irreversibly altered building components, essential information about the function und architectural history of the buildings will get lost irrecoverably. A holistic acquisition of the building is the foundation for obtaining at least the irretrievably lost, intangible information by for instance multimedia applications and intense inventory and prospection. A detailed construction diary and documentation of all building technical alterations is with the use of a database practicable but now. Only by using a database a retrospectively contextualization of information is possible, in other words, a monument preservation in an intangible way.

Implementation and therefore archiving of the information and so the individual stages of a restructuring concept is often the only chance to perform the observed destruction of historic building substance conscious and planned. In this way no important information and documentation steps will get lost and the building will not lose its status as a historical Monument or generally lose its character.

Modern database systems offer just that. They allow builders, owners, conservation institutions such as the CERKAS and ministries via different access levels and privileges a kind of controlled participation in historical and future changes and thus a targeted and predictable financing, adapted to the different restoration steps. An essential advantage of newer databases is for example the fuzzy search on Boolean combinations. Different keywords for a searched circumstance/structural detail, different spellings (e.g. transliteration / transcription) of a term and the combination of different languages by a so-called fuzzy search lead to a larger result set, as in the recent truth values retrieval.

Many information that were already gathered and implemented within other projects in databases (Kölbl, Boussalh, Hostettler, 2005), should be adopted upon consultation in the new project.

The variety of existing and collected information is ranging from narrative, descriptive sources, archive materials, cartographic data up to artefacts from the Kasbah or the surrounding Ksar. As expected a vast number of different data formats have been generated until now, like CAD, GPS, text, image, movie, etc.

Because of the complexity and the size of the Kasbah with its various different historical utilization concepts, the aim is to expand the method of acquisition to other Kasbahs. Consequently the long time orientation of the project is an important determination – for example the system should be flexible and compatible with upcoming updates and extensions – as well as an efficient access to all gathered data is necessary for all partners. Within the framework of an interdisciplinary project between the faculty of design (department of architecture) and the faculty of technology (department of electrical engineering and informatics) of the University of Applied Sciences Wismar, supervised by Prof. Raab-Düsterhöft, the conception and programming of a database for Kasbah (Tamnougalt) has been started.

Our database rests upon the Conceptual Reference Model (CRM), which was released 1999 by the Comité international pour la documentation (CIDOC) from the International Council Of Museums (ICOM). This CRM became 2006 the ISO-Standard (ISO 21127:2006) for the controlled exchange of information concerning cultural heritage. On December 2014, a new version (based on version 5.0.4 of the CIDOC CRM) became available: ISO 21127:2014.

For example a research team from the University of Rostock applied and adapted this database system in an EU-project for the inventory of cultural landscape elements in recent years (Meyer 2009).

This project and all the gathered experience is a good basis for the now started and in this article presented project.

2. Functions and capabilities of CIDOC/CRM

The inventory methods by using database and GIS-technique revolutionized in the last decades. Counting management systems allow an essential improvement in the inventory work. But nevertheless it's of particular importance to really understand the determinations of each single fact and data and to advance the system from a simple digital 'chart box' to an intelligent system.

Our database should not only concentrate on the integration of cultural heritage information by implementing heterogeneous material, it should allow also the mediation through the different material to come to new results, new interpretations through a multi-dimensional context relation of unstructured information. Because: the interaction of human beings with their surrounding is more than a one way street, where men are creating the landscape actively. The landscape initiates the will of the people for the cultural creation of the landscape as well.

2.1. Heterogeneity of information

The gathered/existing information from and about the Kasbah in Tamnougalt are not only contentual, but as well formal/structural very diverse.

For the inventory all the different types of data and information are assigned to different categories (Figure 1):

- structured information (data-oriented facts like measurements, floor plans, CAD data)
- geo-spatial information (like GPS coordinates, positions, areas, room book ..)
- temporal/chronological information (construction/reconstruction phases)
- unstructured and multimedia/document based information (historical and actual maps, pictures, web content, texts, video, audio, animations ..)

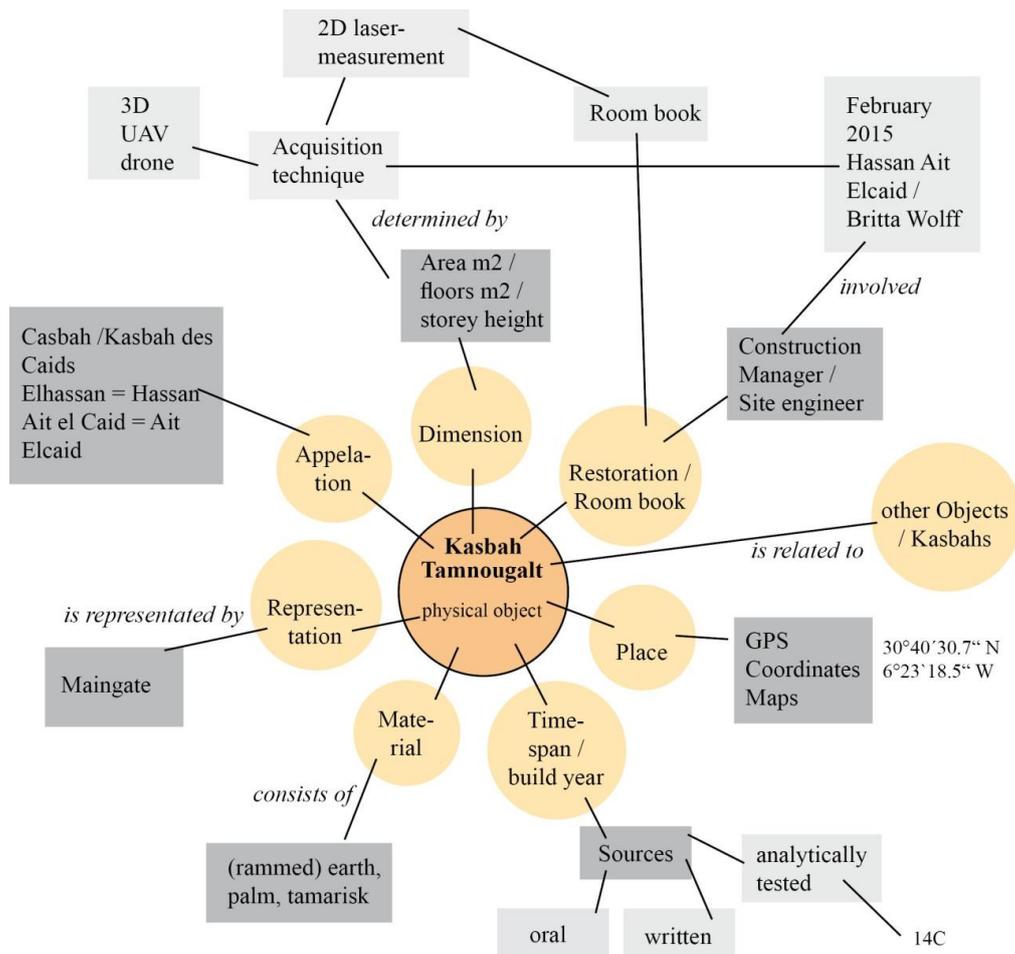
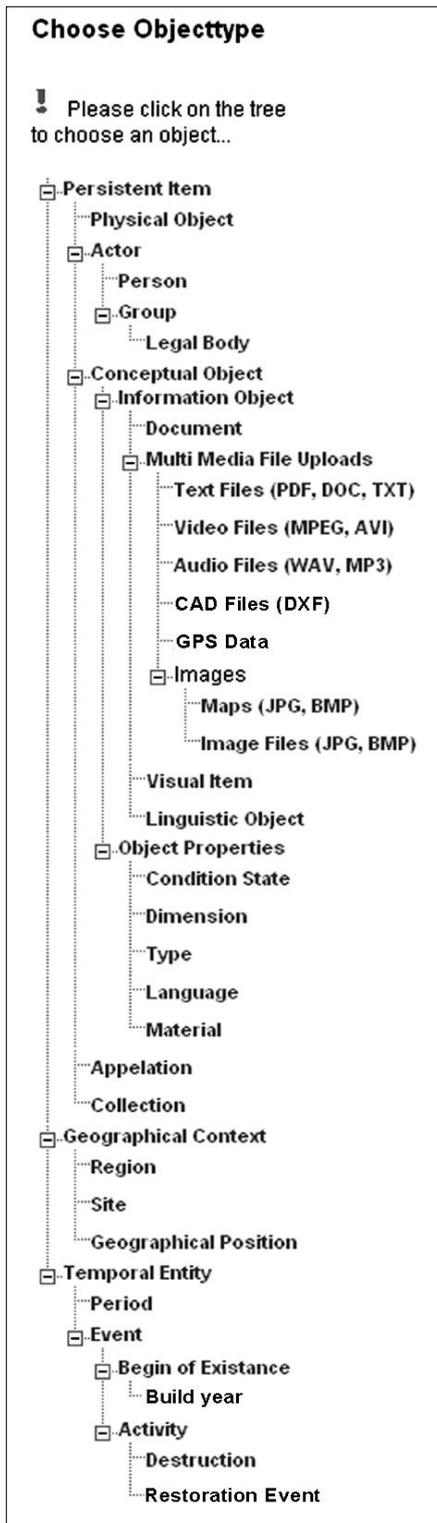


Figure 1: Different facets of the Kasbah in Tamnougalt and the related objects /Kasbahs allow a generalisation and therefore comparative perspectives



Structured information

Because of a lack of correct floor plans of the Kasbah des Caids of Tamnougalt, one of the first important steps of our inventory work was the measurement of the whole Kasbah with 2D hand laser instruments. The students gathered horizontal and vertical proportions of the very complex built Kasbah. The measurements were implemented in a CAD program and a 3D model of the whole Kasbah has been generated. The 2D floor plans are the basis for the room book, described in the following passage.

Geo-spatial information

After the adaption of the three floor plans to one another (for example the walls are partly not rectangular and become narrower in the upper floors) the creation of an universal room book was started. This room book allows to understand, organize and at least link many other information in different data format.

To understand the very complex and nested building and to define the border walls, mostly shared with the neighbors, we used in addition an unmanned aerial vehicle (UAV, Fig. 5) to conceive the nowadays Kasbah size from aerial perspective. Because of the partly confusing building structure and the fact that some ground level parts of the Kasbah are invisible from the air, the classical method of tachymetry for the measuring of reference points has been applied (see Figs. 3+4).

The combination of these two technical methods allowed incidentally very interesting insights not only in the former and nowadays property situation and consequently in the origin utilization concept, but as well in the wastewater system of the Ksar and consequently in the dependency of Kasbah and Ksar.

A 3D digital terrain model and profile of the Ksar (see Fig. 6) had been generated and will be linked as well to the floor plans.

Later on it is projected to inventory the most important and interesting areas/rooms inside the Kasbah by 3 D laser measurement (see Fig. 7).

Temporal information

Unfortunately, there are not so many trustful written sources about the building history and real age of the Kasbah des Caids of Tamnougalt. The Kasbah is called 'mother of all Kasbahs' and supposedly more than 500 years old. To confirm the oral heritage, several wooden pieces from significant old doors of the Kasbah will be analysed by ¹⁴C method. Ideally there is compliance between the oral and analysed information and several building-, renovation- and modification phases can be defined, respectively confirmed. The examination of this temporal information is really important to understand former, original functions of room regions in the Kasbah and of course the historic private and official route guidance through the Kasbah.

Figure 2: A holistic analyse and implementation of an object into the database allows multidimensional interpretations from different directions of the ontology



Figure 3: Flight altitude of the unmanned aerial vehicle (UAV): 120m, 4 short flights with longitudinal and cross imbrications of 80%, ground resolution 3cm, marked air track of the second flight (red dots).



Figure 4: Aerial view from the Ksar of Tamnougalt, additional terrestrial measurement for ground control points.



Figure 5: Drone (UAV), multicopter type Astech Falcon 8

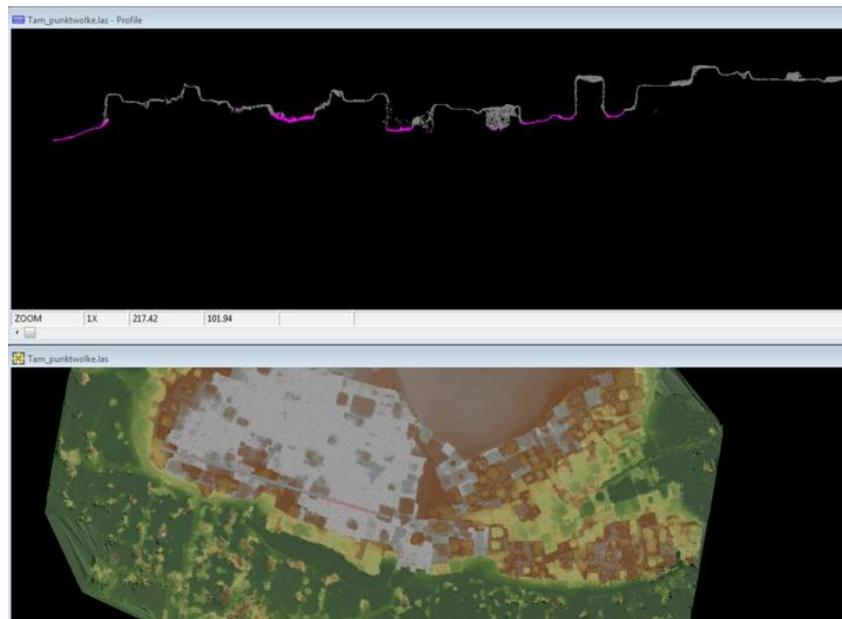


Figure 6: Profile of the Ksar, generated with the measured point cloud



Figure 7: Indoor laser measurement of all relevant/interesting areas of the Kasbah. On the right the hammam of Kasbah Tamnougalt. Interpretation with 3D studio max

Unstructured, multimedia, document based information

Most of the gathered information from Kasbah des Caids of Tamnougalt has to be matched to the category 'unstructured'. There are for example several old photographical documentations which are added by nowadays perspectives now. There are of course several old travelogues, maps, web content and since February 2015 a vast number of pictures from every room (according to the room book) and from several interesting building details. Furthermore, a professional German documentary film team filmed every single step of the first student renovation workshop and some interviews were conducted. So we have at least historical and actual pictures/maps, web content, texts, video clips, audio clips ..

2.2 The Structuring of information

The structuring of information has a main impact on the kind of storage, but as well on the search function and illustration facilities. The more structural information is gathered, the better are the search- and research opportunities. Especially the acquisition of geo-spatial and temporal attributes is essential for the understanding of historical course of architectural intervention, eg. restoration phases and thus former usage.

Spatial, temporal information

The geo-temporal context is essential for the gathering of cultural landscape elements like architecture. Geo-information systems are the adequate technical medium to administrate that information. Object relational database systems like Oracle and DB2 offer for example extensions which allow to gather geo spatial and temporal attributes and to retrieve them adequate. Geo spatial relations like 'is part of' or 'is next to' or temporal relations like 'happened before' or 'happened after' have to be determined. The results will be illustrated in a map or in a timeline. The structure information is generally represented by more abstract object descriptions and corresponding metrics, either in a temporal or geometric way. Geo-referenced objects use appropriate coordinate systems and GPS information. The objects themselves are represented by points, areas or polygons.

Unstructured information

Unfortunately, it's not easy to find adequate structures for all apprehending information, because they do not exist, cannot be specified or frequently change. Often the properties are individually designed and thus no meaningful summary with a uniform scheme exists.

Besides web content text documents, technical articles, video or audio (interview) clips etc. are classified as unstructured content. It is typical that only a few (meta) data are given, such as author or title of an article, but the structure of the document rather follows compositional practice (section, paragraph, ...) and thus isn't very helpful for the search. The search is based a bit Google similar on keywords and does not provide exact results. In fact, sorted result lists are delivered (according to a system calculated relevance), which may contain from the user's perspective many irrelevant documents.

In addition to the traditional text documents, also multimedia documents like audio, video or image files but as well 2D or 3D illustrations, animations or other compound documents fall into this class. All have the structure description in the form of a document type scheme in common. Sometimes there exist some exceeding information in the form of metadata (title, author, classification, keywords ...). Either the multimedia content can be made searchable via the detour of a textual description, or it must be used specific, content-based search methods that have to be newly developed specifically for this application. Unfortunately, current systems provide just little support.

2.3 Contextualization of information

Contextualisation of information means in our project the context of the Kasbah des Caids of Tamnougalt with other elements of the cultural landscape, independently of their structure. For example is it very interesting to know besides the form, structure, location, date of completion, stylistic era etc. of a building as well something about its embedding in the cultural landscape and its use over the decades and centuries.

The Kasbah des Caids of Tamnougalt, as origin of the database, shall be set in future in context with other Kasbahs in a previously defined area of Morocco (south Atlas region, Drâa and Dades valley). For this purpose a special classification following cultural landscape aspects will be developed.

Individually gathered objects (buildings like Kasbahs) can be set in context by using this classification (see Fig. 1+2). This context reference is not firmly connected with the objects themselves, because it can change over space and time, can be coloured subjective and can consist of different facets.

While the information concerning the cultural landscape elements themselves are relatively firm, the relationships between the objects can be various and changing. Networking allows to combine and to contextualize different objects and groups of objects and thus to establish relationships between different structured elements.

2.4 Complex evaluation and research methods

From the appropriate form of information structuring arises, as already mentioned, the way of possible evaluation and research. While this may be quite extensive for well-structured information, research opportunities for geo-spatial and temporal information are of a different nature and quite limited in unstructured documents. Within our cultural landscape inventory we have all the three forms of data and thus need a combined evaluation and research. We now briefly characterize the different research forms and will see then, which combined evaluation mechanisms can be used.

Structured data can be browsed with exact retrieval languages like SQL not only for specific attribute values comparisons, but they can be assembled by Boolean combination (with AND, OR, NOT) or can be formulated

as range queries and in any arbitrarily nesting. The result is usually exactly the amount of records that correspond exactly to our requests.

Concerning geo-spatial and temporal queries in rarely cases the information is inquired, which is exactly at a point in space or time. Rather, it is mostly about the proximity to a requested item. In the neighbourhood search the main concern is the retrieval in a defined environment or a defined number. The results are sorted according to their distance from the requested point. Furthermore, the query corresponding geo-spatial or temporal relationships, about which objects are located in a specific region (house, level), is of our interest.

The search in the unstructured information is often keyword based or uses tags from a classification, a thesaurus or ontology. The problems of content-based search in multimedia documents has already been mentioned, the detour via textual descriptions and techniques of information retrieval on text documents is often the only solution. Results are provided by the system with a corresponding rank and are released as a list to the user, sorted according to this ranking.

3. Aim and future prospects of the project

The aim of the project is to develop an information system for the inventory of historical cultural (landscape) elements using the example of the architecturally unique, Moroccan Kasbahs, starting with the probably oldest one in Tamnougalt.

The process of inventory includes the acquisition, management and representation/illustration of elements of the cultural landscape. These elements represent information about objects, events and actors with respect to the cultural landscape. In order to offer users an intuitive operation and geographic analysis tools, the system integrates a complete GIS infrastructure. By combining GIS objects with other information the access to non-geographic data on map-based research and navigation functions is possible.

The database will be developed under leadership of the University of Applied Sciences Wismar, Germany with support of Moroccan Institutions like CERKAS.

Whereas it is an open space and later on open access tool, the user interface should be programmed and designed as intuitive as possible with consideration of the different cultural-regions and thus cross-language usage.

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