FROM DATA TO INFORMATION: METHODOLOGY FOR A GIS BASED HISTORIC BUILDING CONSERVATION PROJECT

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Abstract:
Historic building conservation is a systematic process where the data collected about the building through the survey phase, and evaluated and used as information through the evaluation and decision making phase. It is a value based approach so that for an appropriate conservation process, the values, potentials and problems of cultural heritage need to be established. The possible interventions or conservation criteria are decided as far as these values and problems are identified.

Information Technologies (IT) enable to establish a suitable environment for the management of information. They help the user to handle with complex data from different context. Within this scope, Historic Building Information System (HBIS) was designed for the conservation of Doganlar Church, which is a spatial information system built by using GIS. This GIS based building conservation project includes documentation, analysis and evaluation processes, where different kinds of data were used.

HBIS can be classified into four main phases. The first one is the survey phase, which covers the metric survey of the building with 3D AutoCAD and data collection about various aspects. The second phase is the "data structuring". In this phase, the collected data is transferred to the GIS by designing a database and defining a data model. Later, thematic maps on different topics are provided over the structured data. Then the next phase is analysis and evaluations where queries are made between different data topics. Following these phases, all the raw and processed data are visualized in the GIS environment by using a key plan. The assessment of HBIS was criticized between three visualization techniques; 3D visualization in GIS, 2D visualization in GIS and 3D visualization in Microstation Geographics.

This paper aims to analyze the comparison between different visualization techniques through the conservation decision making process of a GIS based historic building conservation project.

1. FROM DATA TO INFORMATION

1.1 Introduction

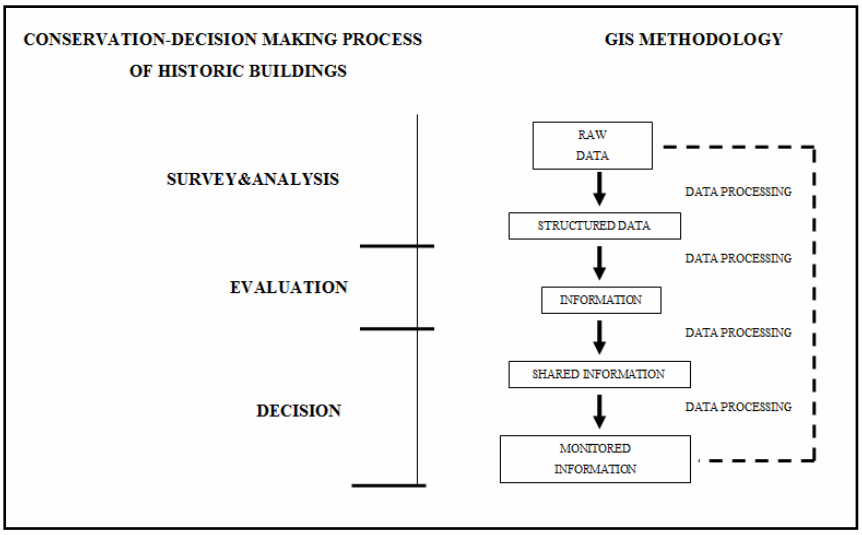
Conservation decision making process of historic buildings requires systematic study and scientifically planned methodology. A successful conservation process of an historic building should include the evaluation of data concerning different aspects of the historic building as well as the data coming from a multidisciplinary study.

The use of comprehensive data from various topics with the coordination of multidisciplinary work requires a medium that combines the analysis and evaluation of this complex data. Spatial Information Systems (SIS) offer the use of huge amounts of complex data. These systems enable spatial data, from different topics and different formats, to be evaluated, analyzed and monitored in the same environment.

1.2 Methodology

From the beginning of the case study, some objectives were defined, it was not known if it would be possible to achieve all or not. Among these objectives was trying to provide a 3D SIS which would allow the data entry, structuring, and management and monitoring. Therefore, from the survey phase onwards data is always collected within a 3D coordinate system. Almost all the building except some details was measured with Total Station. Besides, all the inner and outer facades are photographed with high resolution digital cameras[1], which are then rectified by using photomodeler V.5.0 as a part of the documentation process. During the documentation phase data concerning the main topics defined in an architectural conservation process are also collected.

Table 1 : The relation between conservation process and GIS methodology

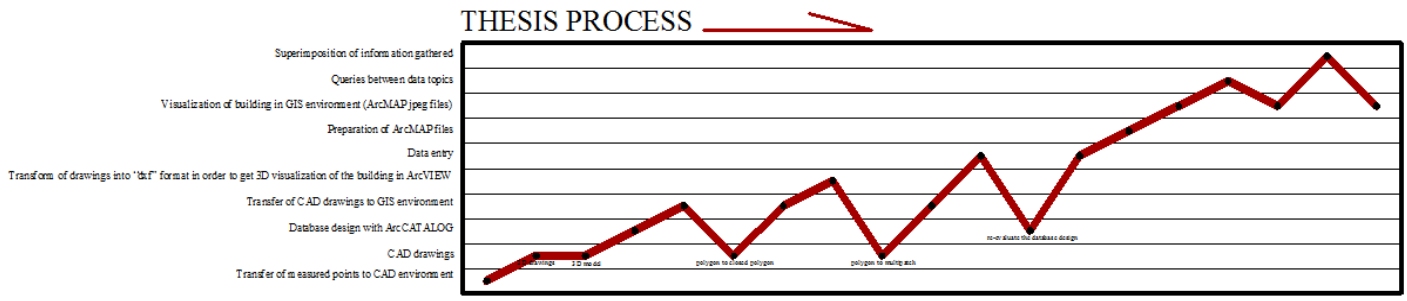


The collected data are later on transformed to CAD by using AutoCAD 2007 and the documentation drawings of the building were produced as CAD files. At this point two parallel studies have been done as producing 2D plan, sections and elevations as well as 3D model of the building.

Although the multipatch geometry in GIS seemed to allow formation of a 3D model, after various trials, the studies showed us that data editing could not yet be possible with a 3D model in GIS without using additional scripts. After that result, this time various other trials are made to design the most efficient system which can support conservation process of a single historic building by using the 2D environment of GIS. Therefore, the data entry was done through the 2D documentation drawings. Following the establishment of the GIS data model with spatial and attribute data, visualization of the structured data and the results of the queries between different topics are made over the sections, elevations and plans. The integration of different 2D drawings and the management of the system are made by the help of a key plan.

Thus, from the beginning of the case study till the production of the final output, there had been a lot of trials, failures, feedbacks and redoing within this process (Table-2).

Table 2 : The process



2. HISTORIC BUILDING INFORMATION SYSTEM (HBIS)

Historic Building Information System (HBIS) was designed for the conservation of Doğanlar Church, which is a spatial information system built by using GIS, namely ArcGIS V.9.0. The aim is to create an environment where the data collected about Doğanlar Church, can be stored, analyzed, evaluated, visualized and monitored.

The important point here is to manage the spatial data with a scientific and systematic approach. For this reason the data is collected, linked to the system in GIS environment.

This system allows storing any data in any format with any extensions; moreover the user can reach the information about the building with any requested form. The information can be a raw data collected during the site survey or the result of an analysis. The important capability of this system is to operate and query the data due to the purpose of your study.

In order to evaluate the use of GIS with different visualization techniques for the conservation decision making process, the building was modeled in 3D *Auto*CAD. Following the preparation of the plan, section and elevation drawings of Doğanlar Church, the 3D model was developed with the points measured with Total Station.

During the data entry first the graphic data created in AutoCAD is transferred to ArcMap as different feature class and attribute data for each feature is entered.

However, the data entry process had not been so unproblematic. Especially during the transfer of both 2D and 3D graphic data created in AutoCAD, the study had to be reconsidered several times. The important point here is the format of the spatial objects at the drawings throughout the transfer of the drawings to GIS environment. At first the drawings were prepared in AutoCAD as polylines that represents the façade or plan objects. During the transfer of these drawings, it was realized that the spatial objects at the drawings (i.e. the plaster covering at the exterior façades, the stone lintels, the brick walls, etc.) should have been prepared as polygons in order to introduce the objects in GIS environment as visible and usable data. Hence the drawings revised and were changed to the polygons and transferred to GIS environment. But again the drawings could not be visualized as usable data objects in GIS. At this phase it is understood that the spatial objects should have been closed polygons in order to be visualized in GIS. Considering this problem the drawing process was repeated and the spatial objects that were created in AutoCAD were changed into closed polygone objects. By this exercise it was understood that, in order to use the spatial objects that were drawn in AutoCAD, it was necessary to draw closed polygone objects.

The other study was maintained with the transfer of the 3D model of the building that was prepared in 3D AutoCAD. The model was prepared as vertical and horizontal elements of the main building and completed with the architectural and finishing elements similar to the database system. At this study the important point was to evaluate the whole building as a complete model in order to visualize the building on different data topics with all components. The visualization of this model at GIS environment could not be possible. Only the model was transferred to the ArcVIEW in which no kind of data query is possible.

3. COMPARISON BETWEEN DIFFERENT VISUALIZATION TECHNIQUES

The components of HBIS of Doğanlar Church were stored through a file system. Each file related to the building stored according to its data type. The utilization of this filing system could be possible through GIS. With the help of this storing system the updated information about the building can also be added, this way monitoring of the building is provided.

First the main file was created with the name “Doğanlar Church”. This file consists of six files that store all the documents due to the file type. First one is the “arcmap files” where the ArcMAP documents were stored. Another file is about the images of the building. This folder contains the image files with reference to their locations. The sketch files that have been prepared throughout the site survey also stored through this filing system and these files were located as sketches under the main file “Doğanlar Church”. Another file folder was created for the text files related to the building, such as the descriptions.

This filing system also provides the organization of hyperlink files. The 2D visualization files were connected through a key map. This key map combines all the information and document about the building such as the sketches that have been made through the site survey as well as the ArcMAP jpeg files. With the help of this filing system all the information and documents about the building can be managed..

The visualization of the data has been assessed by viewing the 2D and 3D CAD drawings of "Doğanlar Church". Different visualization techniques has been compared and evaluated according to their advantages and disadvantages (Table 3).

3.1 2D SIS and Keymodel in GIS

Following creation of database design and the data model, the raw data collected during the survey phase is transferred to GIS environment. The data coming from different sources have been entered into the system in the forming relational database.

The spatial objects created through *Auto*CAD were transferred to the GIS environment with relation to the database system that was created with ArcCATALOG.

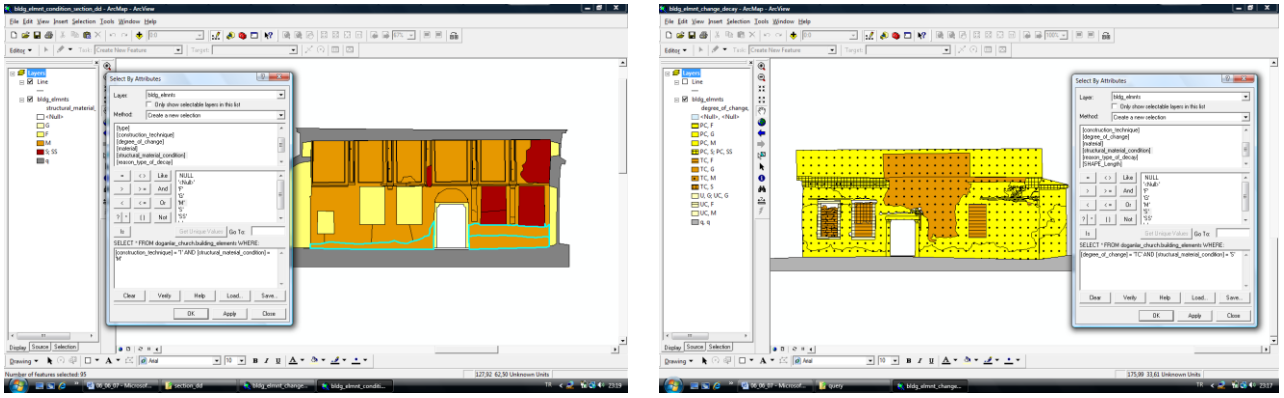


Figure 1: 2D SIS in GIS

2D drawings are integrated with each other in GIS environment through a key map. Each drawing has been established so as to define a relation with this key model. For instance, the elevation drawings have been related to the key model with the hyperlinks placed on to the walls.

The key map that associates the entire study is the plan drawing of the building. The relevance was established by using hyperlinks for the section and elevation drawings as well as the detail drawings. Related drawings were studied on three main topics which are; building with its surrounded context, building space and building elements. These three main groups were studied on the subjects that were decided during the database system design.

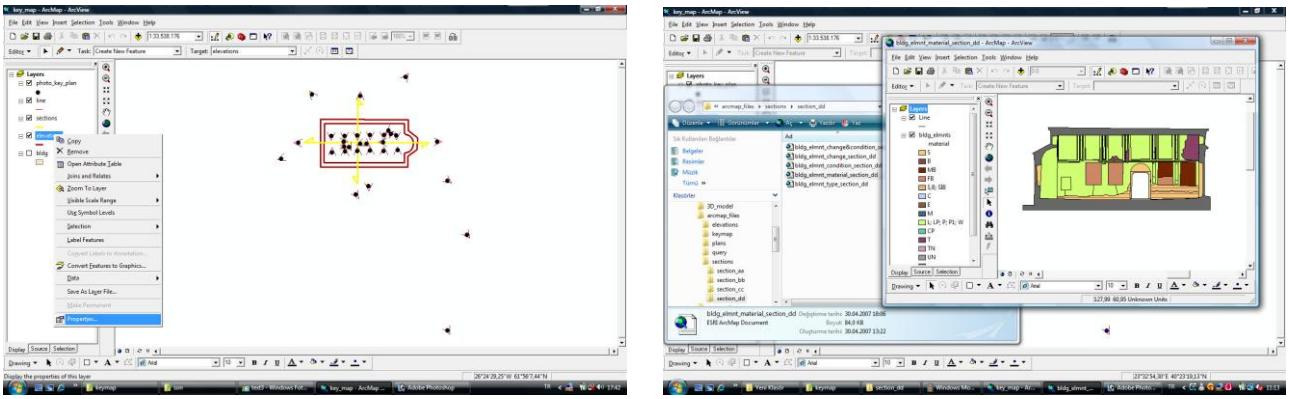


Figure 2: Keymodel in GIS

3.2 3D SIS in GIS

Visualization of the data is provided by the 2D drawings. 3D textured model could not be transferred to ArcMAP and visualization and querying could not be possible. The 3D model could only be visualized in ArcVIEW, but the editing could not be possible through this program.

The reason of the lack of visualization and editing of 3D model in ArcGIS is because the system becomes active for the utilization of data in x and y coordinates system. The system requires data with reference points connected to Earth's surface. With the technological developments or with an additional program the visualization and editing capabilities of multipatch data can be improved for future studies.

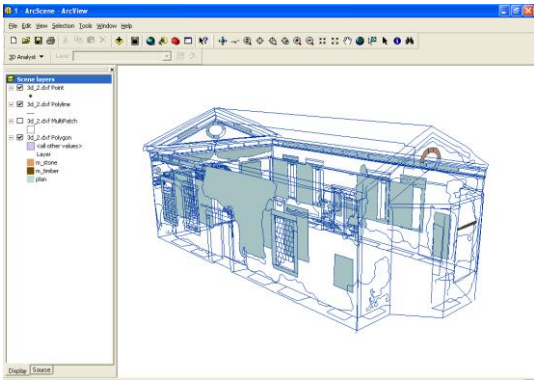


Figure 3: Visualization of 3D model in ArcVIEW

3.3 3D SIS in Microstation Graphics

The use of Microstation Graphics is queried only for certain topics. For further studies it is important to obtain this method in a more detailed way.

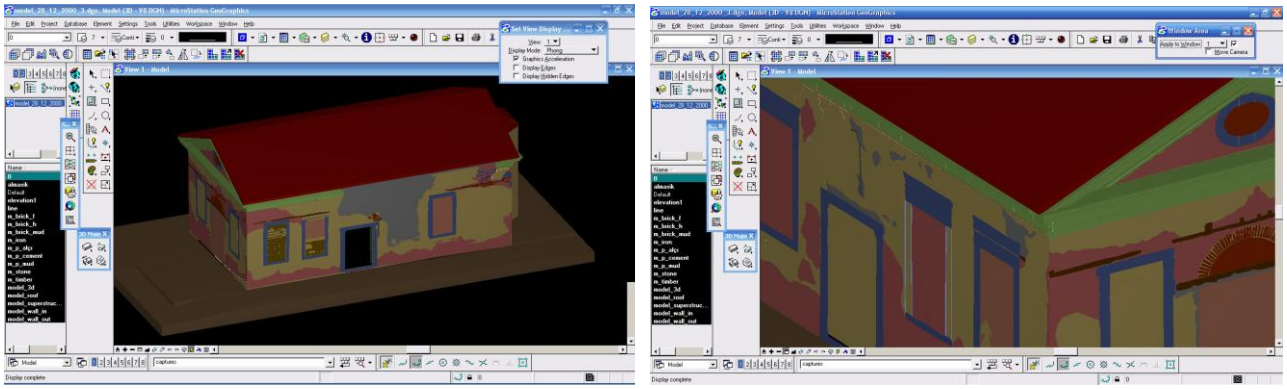


Figure 4: Visualization of 3D model in Microstation Graphics

4. CONCLUSION

Historic Building Information System (HBIS) prepared for Doğanlar Church enables making an assessment of the advantages, disadvantages and problems of the utilization of GIS as a supporting element in conservation decision making process.

GIS is a useful data management tool that enables the classification of data in different formats. Starting from the data entry to the system data is classified and categorized due to the data features. These obtained information can also be visualized in different formats in the system such as; thematic maps, table graphics or charts. This provides the variety in presentation techniques compared to the conventional techniques. The production of these kinds of display opportunities creates more efficient analysis and evaluations. With the help of various queries of different data topics enables more efficient analysis and evaluation phases.

The utilization of GIS in Doğanlar Church also created some problems, such as; editing insufficiency (lack of 3D editing), complex and long preparation phase and limited possibility of renewal of data transferred from other software.

The process of the utilization of GIS in historic building conservation is a new issue. Therefore the process itself is challenge to understand the capabilities of the system properly.

5. REFERENCES

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Table 3 : Comparison of different visualization techniques

	METHOD	SOFTWARES	TIME SPENT	CONVERSION TO SIS AND IMPLEMENTATION IN GIS	ABILITY TO BE MONITORED	QUALITY OF PRESENTATION	EVALUATION OF PROBLEMS	DEGREE OF DIFFICULTY	EVALUATIONS
2D SIS IN GIS	The 2D CAD drawings were prepared by AUTOCAD 2007 program. Rectified images and coordinate points were used.	AUTOCAD 2007 MSR GIS	The 2D CAD drawings were prepared in one week.	2D drawings can be prepared easily.	Update of the information and monitoring is possible.	Similar to conventional method.	Unable to see whole building at the same sheet.	2D drawings can be prepared easily.	Storage and monitoring is an advantage compared to the conventional method. The queries can be made between all the data topics that were decided. Queries about the intervention types are successful.
3D KEY MODEL IN GIS	Key model was prepared in AUTOCAD 2007. The 2D drawings is linked to this model in GIS.	AUTOCAD 2007 MSR GIS	The 2D CAD drawings were prepared in one week. 3D key model was prepared in one day.	2D drawings and the key model can be adopted to GIS and similar programs.	Update of the information and monitoring is possible.	Similar to conventional method.	Unable to see whole building at the same sheet.	2D drawings and 3D key model can be prepared easily.	Key model is a combining element that is an advantage for storing the data. This key model helps to realize the building as a whole. Presenting in 2D drawings make it difficult to understand the building as a whole.
3D SIS IN GIS	The 2D CAD drawings were prepared by AUTOCAD 2007 program. 3D render was prepared in 3D AUTOCAD.	AUTOCAD 2007 MSR	The 2D CAD drawings were prepared in one week. 3D rendered model was prepared in two week.	3D model can not be adopted to GIS.	3D model can not be applied to GIS monitoring is not possible.	Observation of the building as a whole is an advantage.	Unable to adopt to GIS.	The preparation of 3D rendered model is difficult.	Pesentation on 3D model is an advantage to observe the building as a whole in the topics like, material, problems, solutions, etc. But the adaptation problem of the model to GIS is a disadvantage. This method can be improved with the help of technological developments.
3D SIS IN MICROSTATION GEOGRAPHICS	The 2D CAD drawings and 3D render was prepared in AUTOCAD 2007. The drawings uploaded to Microstation Geographics.	AUTOCAD 2007 MSR MICROSTATION GEOGRAPHICS	The 2D CAD drawings were prepared in one week. 3D rendered model was prepared in two week and drawings uploaded to Microstation Geographics	3D model can be adopted to MICROSTATION GEOGRAPHICS and queries can be made.	3D model can be applied to MICROSTATION GEOGRAPHICS and monitoring is possible.	Observation of the building as a whole is an advantage.	Program used is not used so common like GIS.	The program is more complicated.	The use of MICROSTATION GEOGRAPHICS is queried for only some topics because of the limited time, this method should be investigated in more detailed way.