PAPER • OPEN ACCESS

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To cite this article: G C Chionu *et al* 2020 *IOP Conf. Ser.: Mater. Sci. Eng.* **789** 012010

View the article online for updates and enhancements.

Accessibility to Transylvania´s cultural heritage through BIM-Heritage and community involvement

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Abstract. The rural areas of Transylvania offer important resources for developing research in diversity of the cultural heritage. Many of these communities have seen great changes in demographics over the last 30-50 years, and important cultural heritage from previous generations is being lost in lack of understanding, human resources and willingness to preserve the value of our joint cultural heritage. The research seeks a digitisation approach to preserving and promoting the local cultural heritage, as well as a social science approach, which seeks to find answers to how one can be able to preserve, maintain and promote this cultural heritage, something which, according to the study hypothesis, can only be done if the communities see the benefits of doing so. The digital shift has the ability to create another level of understanding, opening a vast horizon for accessibility and progress linked with BIM technology. As an answer to dealing with the climate changes, degradation of the buildings due to natural disasters or more from the indifference of the young generations in regard of history inheritance, the study could be a valuable instrument in enhancing BIM-Heritage methodologies.

1. Introduction

The purpose of this study is to generate a research basis in some of Transylvania's rural areas, villages and towns, capable of promoting a sustainable management of their cultural heritage, with a main focus on the traditional cultural area and to contribute to the development of the multicultural society, while preserving the knowledge of the local history.

The presented study is an early phase of a sizable research project in Transylvanian rural areas. The project examines areas rich in cultural heritage, where Romanians, Hungarians, Saxons and the Roma population are living together in communities, with their own various traditions.

The European Commission has set as an important objective to all Member States to involve and develop strategies and policies on digitisation of cultural heritage. "The EU's strategy for digitisation and preservation builds on the work done over the last few years in the digital libraries initiative." Digitisation is an important means for ensuring greater access to and use of cultural material" [1].

In line with this objective, the research group has developed a strategy for documenting and preserving the local cultural heritage, while promoting its value for economic, cultural and sustainable development in the future.

The tangible cultural heritage includes traditional buildings, structures or landscapes. This includes locations, the environmental relationship, and the building materials. Moreover, the intangible heritage includes practices, representations, expressions, memories, knowledge, crafts and the abilities which are used and transmitted by these communities and groups from generation to generation [2].

Romania is permanently improving the tourism sector, developing sustainable tourism, cultural-tourism, eco-tourism, trying to help in making European strategies to safeguard the natural environment, natural heritage and cultural heritage. Transylvania's cultural heritage (not exploited and preserved enough) is very much appreciated by foreign tourists who are interested in the mixed multiethnic heritage because is easier to integrate as part of Europe [3].

2. Background, approaches and preliminary investigations

Many countries in Europe are digitising on a larger scale immovable cultural heritage and more than 1/3 of Member States reported funding programs for digitisation of monuments, historical buildings and archaeological sites [1].

Romania, an EU Member, has on Digital Day 2019 signed up to the Declaration of cooperation on advancing digitisation of cultural heritage. "The European Year of Cultural Heritage 2018 also created a momentum by bringing all Member States and stakeholders together around Europe's rich cultural heritage and contributed to enhance its visibility" [4].

Created in the frame of developing international cooperation between higher education Institutions, three research teams from Transilvania University of Brasov, Oslo Metropolitan University and University for Architecture and Urbanism "Ion Mincu", Bucharest, combined their knowledge to create a basis for a common research field with a focus on studying the existing Transylvanian cultural heritage. The goal is bringing together advanced expertise in building engineering, architecture, innovation and knowledge in BIM and HBIM technologies by using the opportunity of the field investigations in rural areas. The main research objective is an inventory of the most representative traditional elements from the tangible and intangible heritage in rural areas, from Transylvania's Central Region.

The research focuses on old Saxon-villages from Brasov county like Ticus, Racos, Soars villages and other un-exploited rural mixed population communities. Apold and Dealu Frumos, villages from Mures and Sibiu counties, are amongst other villages in the region which are studied with a view to finding ways of preserving the cultural history while enabling sustainable development, and tackling complicated societal problems which effect development in the region.

The academic teams involved in this study have since autumn 2018 been working on development of the academic platform required for in depth studies of the communities and successful dissemination of the acquired knowledge.

A key goal of the research is to directly use the knowledge of the past to help maintain the societal systems, infrastructure and management strategies which have been working well, and using this in education and aid of the communities that are currently residing there. Additionally, the research aims to use the knowledge acquired about the landscape, building mass, natural resources, culture etc. to help the communities develop long term sustainable strategies, infrastructure and systems for improving their lives and the society.

The research strategy involves investigating and documenting the region, and presenting the findings in easily understandable and accessible formats. The researchers are using advanced digitisation techniques and presenting many of the findings through 3D modelling, CAD, BIM, HBIM, image, video and virtual techniques.

All the participants in the study from the teams from Romania and Norway have different approaches and profiles offering diversity to the research project. Transilvania University of Brasov with the Faculty of Civil engineering brings expertise in field research, topographic measurements, urban planning, construction and rehabilitation. Oslo Metropolitan University has strength in advanced BIM/HBIM technologies, GIS and virtual presentations, and the "Ion Mincu" University for Architecture and Urbanism in vernacular architecture, cultural heritage and landscape preservation.

The cooperation supports creativity, and the discipline interference will sharpen their identity. The scientific experience from the engineering field focuses on technical BIM and HBIM, the architecture field focuses on historical data and 3D modeling, spatial and volumetric approach, while the urban-planning field focuses on territorial developments and cultural landscape. The research strategy is structured in 3 main phases:

- the initial phase includes in the first part exploration and selection of the areas with the highest cultural potential, where the feed-back from the communities is the most positive and which has most relevant perspectives in developing a sustainable development;
- the second phase is a digitisation approach to preserving and promoting the local cultural heritage and also a social science approach. It seeks to find answers in relation to the rural communities and how one can be able to preserve, maintain and promote this cultural heritage. This can only be done successfully if the communities become aware of the benefits of such activities.
- The two initial fields of research will lead to a third phase and field, which seeks to highlight the red line, and the interconnectivity, between the previous two fields and the key topics of the research field.
- The third field entails using state of the art technological solutions like 3D laser-scanning, advanced measuring techniques, and BIM modulation, and turning it into an interactive solution with focus on documenting and preserving the cultural heritage. The HBIM approach will provide an inventory of documentation in construction and conservation of the cultural heritage studied [5].

The computational approach will preserve knowledge and scientific information but will also be a bridge for providing communities with an overview of their civilization background and support continuous development. Using the latest methods of presenting the study results (know-how, media, video dissemination, interviews), will provide a basis for cultural education activities, especially in disadvantaged communities.

BIM – Building Information Modeling has been defined as "a digital representation of physical and functional characteristics of a facility, a reliable basis for decisions during its life-cycle; defined as existing from earliest concept to demolition" (The American National Building Information Model Standard Committee) and the last advance technologies confirm that BIM has been classified into several maturity levels:

- level 0D – refers to the zero baseline,
- level 1D – refers to the (the initial) point,
- level 2D – refers to traditional 2D line drawings,
- level 3D – refers to the three primary spatial dimensions (width, height and depth),
- level 4D – refers to the fourth dimension of time and sequence,
- level 5D – refers to 3D + time (schedule) + costs,
- level 6D – refers to the Lifecycle Management and Facility Management in what is delivered [6].

The transition to the HBIM – Historical Building Information Modeling, has been gradually done over the last 10-12 years due to the necessity of considering part of the Lifecycle Management additionally to the existing buildings and also the historical monuments.

So, the actual BIM approach, which stats from 0 to 6, 7D can't be applied for something which has already been proven over the decades or centuries and where the Lifecycle Assessment do not have a data basis containing 2D, 3D/CAD information. The goal in HBIM is focusing on Conservation, Repair and Maintenance (CRM). The approach is clearly broader then including CRM as a definition, also integrating digital technologies support, laser scanning, survey options, thermal scanning etc, the results become complex with multitude use and users in specific communities [6].

Current maps and historic maps will be compared to determine the nature and the landscape changes over time. GIS (Computerized Geographic Information Systems) and topographic measurements will

determinate the rural landscape characteristics and spatial settlements by using typical operations such as map overlays, distance calculations, and interpolation.

These operations can also be used to define the boundaries of properties and to assess the visual impact of land use changes [7].

3. Feed-back and answers from Transylvania's communities
Argumentations in selecting areas:

- the database of Brasov's county strategy contains little information about the selected rural areas;
- the sustainable development principal focus points are: equity and equality;
- the objectives selected for the study are complementing the existing touristic maps.

The selected areas are not included in the main touristic routes of Transylvania Center region, and the local communities need support in promoting their own values. By doing research in these territories, the future development will bring about economic, social, cultural integration while diminishing the migration of local population to the big cities.

Transylvania features many historic cultural resources, the Saxon villages which have been confronted in the last 3 decades with massive depopulation, due to the migration of Saxons when their German-speaking inhabitants emigrated to Germany in the 1990s. Similarly, part of Romanian and Hungarian populations migrated in search for better life quality to the bigger cities of the country or abroad.

In Brasov county there are numerous depopulated or abandoned Saxon villages, with only a small number of inhabitants, Romanians, Hungarians or Roma population in need of assistance to revitalize their rural habitat. Beautiful medieval fortresses, and fortified churches in poor condition, ruined structures are specific for the local rural areas.

Villages where in the last 10-20 years, the birth rate dropped rapidly could still be very interesting areas with valuable cultural heritage for tourists, also due to their pristine natural and wildlife surroundings.

The research team of Transilvania University of Brasov (UTBv), being located in Brasov city, has conducted preliminary investigations in the rural communities, which are willing to enhance their cultural heritage. During the initial phase, the researchers have been developing working relationships with a few local foundations/NGOs, cooperating with local and regional authorities to establish partnerships and collect important public data, including links with rural planning and local strategies.

Descriptions of some of the communities that the research project is studying:

- Ticus is first mentioned in 1373 as an old medieval Saxon village, as in figure 1, having mixed population (Romanian 65.08%, Hungarian 18.94%, Roma 12.11% and others), a Fortified Evangelical Church (XVth- XIXth century), monument in Ticusul Vechi (figure 1) and Reformed Church (XVth- XIXth century) in Cobor, as in figure 2 and figure 3.

Figure 1. Ticuș village – the main street (photo from author´s collection).

Figure 2. Cobor village – Fortified Reformed church tower (photo from author´s collection).

Figure 3. Cobor village – Fortified Reformed church (photo from author´s collection).

- Racos a medieval Saxon village with mixed population (Romanian 22.27%, Hungarian 52.18%, Roma 20.27% and others), having an old monument Sukosd-Bethlen Castle built in 1625 in the Transylvanian Renaissance style, as showed in figure 4 and figure 5, surrounded by beautiful landscapes, with an old volcano, a basaltic scoria quarry (The Brazi Quarry) and the Emerald Lake, as great touristic attractions [8].

Figure 4. Racoş village - Sukosd-Bethlen Castle (photo from author´s collection).

Figure 5. Racoş village - Sukosd-Bethlen Castle (photo from author´s collection).

- Apold village, Mures county, has been founded before the Saxons arrived and first mentioned in 1309 (Romanian 22.27%, Hungarian 52.18%, Roma 20.27% and others). The 13th century Church (figures 6 and 7) erected in a strategic position on top of a hill surrounded by the river Şaeş, evolved later into the famous fortified church of Apold. The ensemble survived turbulent times and stays even today almost entirely preserved, with fortification walls, defense towers and storage rooms [9].
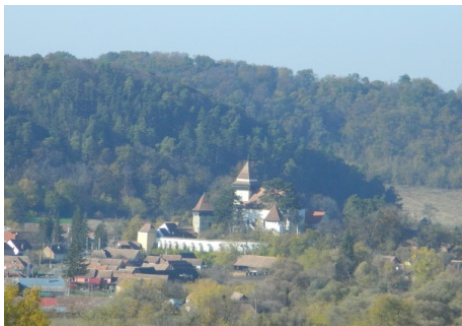

Figure 6. Apold village - The Evangelic Fortified Church (photo from author´s collection).

Figure 7. Apold village - The Evangelic Fortified Church (photo from author´s collection).

The enhancement on multiple levels of the rural heritage implies identifying and analyzing the natural-risk factors, with a view to determining the conditions wherein regeneration, restoration activities, as well as other types of human interventions, may be initiated and conducted.

The present study starts from the method of zoning on geographical sections, which allows identifying several habitats, as well as creating zoning categories.

Approaching the issue of the traditional habitats in the light of the cross- cut zoning is achieved in the context of the old traditional urban planning, historically inherited in each village with the general frame for conducting the aforementioned activities.

As regards the Transylvania region, and especially rural villages, reaching the proposed objectives is conditioned by the following aspects:

- inclusion in the analysis of all components and activities afferent to the rural habitat (buildings, landscaping elements, restoration and real-estate activities etc.);
- inventory of the natural and historic-patrimony elements specific to the studied habitat. An investigation in situ was made upon all the habitat elements which convey overall the specificity of the studied region;
- rehabilitation of the landscaping component of the habitat, against the background of the conservation and development of the community's traditions within the natural environment, as strategic stimulating element on a rational basis, of the rural tourism and agro-tourism;
- identification of solutions with a view to maintaining, if possible, the plotting of the area and the existing structure of the households, keeping withal the neighbors areas, given the significant influence of these administrative aspects on the natural landscape and the architectonic traditional elements [10].

4. HBIM contribution in Transylvania's areas

The BIM-sub-group of OsloMET University is doing research with a broad spectrum: processes related to utilization of BIM-related technology, implementation of BIM in the industry and education, BIM supported sustainability assessment, transformation of processes for professional work and collaboration.

The research is focusing on the information flow through the entire life cycle of the built environments. HBIM will be an important tool in the research project and the way of presenting findings, but it is only one of the tools needed to reach the researcher's goals of delivering an end product generating benefits for the local communities, tourists, historians and our globally shared cultural heritage [11].

Linking the technologies from measuring, imaging, CAD to HBIM for the future phases of the research is a key technical challenge that has been integral to this study.

Much of the "state of the art" aspect lies in the combination of technologies and in how they are applied. 3D laser scanning, advanced measuring, high detail photography, non- to minimum invasive investigation tools (tiny inspection cameras for example, or samples) of buildings have been done before. This project delivers amongst other outputs, very advanced "passports" or libraries, with extensive information for selected cultural heritage objects. For buildings this could be everything from volumes, materials, history, functions, state of maintenance, energy needs, clues for improvements, risk analysis, and much more.

The process of studying in great detail the cultural objects, including buildings and monuments will present several technological challenges:

- individual passports for each of the studied cultural heritage objects, and next,
- creating an extensive topographic analysis, and a 3D map of the village and surroundings, and a high detail model of selected parts of the village;
- taking the individual passports and implementing them in a wider presentation of a research project, and through a map function linking the individual passports to each other, to the geographical location and allowing the users to explore these objects in detailed ways.

5. Conclusions

This study which was conducted as a preliminary investigation and pathfinder for a greater research project "Re-discovering the Traditional and Cultural Heritage through nonintrusive techniques and HBIM based digitisation for sustainable Transylvanian rural communities" has identified important parameters in the continuous development of the research platform.

The research will build knowledge and competences in the following fields: the cultural heritage approach, innovative BIM technologies, advanced graphic presentations with high intuitive and educational focus, and rural communities and environment curricula. Due to inter-disciplinarity, inter-institutional, and international cooperation this approach will allow the new generations of students to participate in future research; based on multicultural links and diversity in a networked environment.

HBIM concepts in addition to providing advanced data about the existing historical buildings, which includes architectural and structural parametric rules, will connect the objects with the areas generating a mapping system with specific libraries. The local communities will benefit directly by acquiring knowledge about the building types they live in, and about methods to maintain and improve them, as well as from being known and placed on the map of cultural heritage, to several levels like educational, preservation, cultural, international visibility and socio-economic development. Very careful considerations must be taken to balance the requirements and constraints of HBIM tools, ease of sharing through close compliance with suggested standards, with delivering a sophisticated graphical presentation of the totality of the data and the cultural heritage one aims to share. The goal of the researchers is that the complex research and IT-platforms developed within the project, be used by the local communities for enhancing and preserving on its basis their cultural life and traditions. It is essential that the platform development operates with a focus on limiting the financial expenses, while being capable to deliver a high quality graphical output, with less power consumption. The need of practicing optimized environmental sustainability in the operations of the graphical end product should be a guideline for further development and innovation of the digitised solution.

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