Cloud data sharing and exchange of HBIM projects for archaeology: possible solutions and proposals

Proceedings of the joint international event 9th ARQUEOLÓGICA 2.0 & 3rd GEORES, Valencia (Spain). 26–28 April 2021

Received: 11/11/2020
Accepted: 27/02/2020

CLOUD DATA SHARING AND EXCHANGE OF HBIM PROJECTS FOR ARCHAEOLOGY: POSSIBLE SOLUTIONS AND PROPOSALS

Filippo Diara*, Fulvio Rinaudo

Department of Architecture and Design (DAD), Politecnico di Torino, Viale Mattioli 39, 10129 Torino, Italy. filippo.diara@polito.it; fulvio.rinaudo@polito.it

Abstract:

Nowadays, archaeological research requires safe and stable digital platforms for ensuring data protection and exchange. For this reason, the creation of anonymous 3D models is no longer enough if semantic information is not dynamically included. Historic Building Information Modelling (HBIM) has proved to be one of the most suitable solutions in order to preserve historical and semantic information concerning archaeology and Cultural Heritage in general, realizing a real breakthrough and avoiding data fragmentation of digital humanities studies. However, the other fundamental goal of this informative system, apart from being a secure 3D DBMS (DataBase Management System) for data documentation and analysis, is to be a dynamic platform designed for data exchange and online dissemination for spreading collaboration and interoperability processes. In this regard, the actual panorama is characterised by different commercial and open source solutions based essentially on a 3D space for model visualization coupled with an integrated basic or advanced DBMS for managing data through analyses, queries, reviews and validations. However, how can these solutions adapt to archaeology purposes? This work in progress is focusing on a quick analysis of possible solutions for online data sharing and exchange of archaeological studies through actual cloud-based platforms also proposing an ideal online HBIM platform suitable for the archaeological domain.

Keywords: archaeology, cloud-BIM, data exchange, dissemination, HBIM, server-BIM

1. Introduction

Data publication and communication is crucial for sharing data at the end of archaeological analyses. This data and information exchange have to be planned in suitable ways to satisfy user needs, because dissemination is the dialogue moment between who contributed to the research and who is getting the final data for analyses and revisions. Since dissemination and data exchange issues referred to traditional archaeological and humanities studies have become more emphasised especially in the last digital age, Historic Building Information Modelling (HBIM) methodology has achieved more and more attention especially for avoiding data fragmentation, allowing and encouraging the correct data management and consequently the right data exchange.

For this reason, the creation of bare three-dimensional models of archaeological sites and structures is no longer enough in the actual research panorama: digital twins make sense only if semantic data are included and dynamically linked to models, allowing to extract desired information via ad-hoc queries (Diara & Rinaudo, 2020).

Moreover, studies carried out via BIM methodology require a smart data exchange and dissemination for guarantee a multidisciplinary and open approach, and cloud-based platforms are fundamental for this reason.

This work in progress is based on a quick analysis of actual cloud-based BIM solutions for online data sharing, trying to understand whether their architecture could adapt to archaeological information, also proposing an ideal solution for this data.

2. Data sharing and exchange

The online dissemination of BIM projects is essentially based on consulting and managing IFC (Industry Foundation Classes) files and related data derived from AEC (Architecture, Engineering & Construction) projects. For this purpose, third-part solutions, as web-servers and advanced online viewers, are fundamental instruments in order to ensure an open and collaborative approach to BIM projects. Integrated DBMSs semantically linked to 3D parametric models constitute the essential backbone of these software (which are characterised by a clean and more intuitive graphic interface than BIM client software) in order to extract information from IFC files through relational queries for data validation.

This accessibility proves to be fundamental for archaeology and in general for Heritage assets, both for new projects (e.g. for risk assessment) and to make available past Cultural Heritage researches. In this case, the collection and management of DBMSs or paper-based datasheets could be considered the most crucial

* Corresponding Author: Filippo Diara, filippo.diara@polito.it

step of this process before the dissemination and data exchange. Fragmented data, derived from past studies, should become crucial connections that hold the HBIM project up.

3. Cloud-BIM solutions and proposal

3.1. Cloud platforms

Existing cloud platforms panorama consist of suitable stand-alone solutions for sharing IFC objects and their information, in addition to the integrated cloud solutions of popular commercial software.

Actual cloud-based BIM software is essentially based on a 3D space and a basic or advanced DBMS for managing data in a collaborative environment (Logothetis, Karachaliou, Valari, & Stylianidis, 2018).

BIMData Platform (2020) is a smart web platform for sharing BIM projects through the upload of IFC files and related data. This web solution is based on XEOKIT, which is an open source programming toolkit developed by XEOLAB for BIM and AEC graphics. XEOKIT source code is available through XEOKIT SDK distribution for the purpose of allowing customization of the main structure. Inside BIMData platform the project manager can easily handle files, users and workflow in a user-friendly environment. IFC files visualization is guaranteed by the 3D viewer (based on HTML and JavaScript) which allows the exploration and investigation of the IFC structure and objects properties, also allowing attributes modification (up to stable version 0.8.26). Inside the viewer, IFC objects can be easily reviewed by selecting BCF (BIM Collaboration Format) option which allows to report issues and revised version of the project. Apart from IFC files, BIMData platform can host any file type associated to digital models: images, PDFs, datasheets (CSV, XLSX, MySQL and others) can be consulted and updated inside the web environment.

Another solution to take into account is represented by BIMserver.center package (BIMserver.center, 2020). It is a cross-platform for data exchange of BIM projects (IFC models), accessible from every device. It is also composed by an important store that includes stand-alone apps and plugins to make the project usable on the web platform, allowing several analyses. Another important feature is related to the possibility to access the project in a VR (Virtual Reality) and AR (Augmented Reality) environments, giving fundamental support to accessible and immersive analyses.

An open source solution is characterized by BIMServer web platform (see GitHub, Inc, 2021), accessible via JavaScript server app. It allows sharing (by using an online server or by localhost) BIM projects and related IFC objects (Logothetis, Karachaliou, Valari, & Stylianidis, 2018; Diara & Rinaudo, 2018): it is essentially based on the investigation and revision of parametric models belonged to AEC families and these analyses could be performed both on 3D space and semantic data.

3.2. A proposal solution for archaeology

Regarding archaeological documentation and analysis, there is no purely dedicated software both for HBIM design and sharing processes. This issue is due to AEC inclination of BIM. Other applications could be considered methodological adaptations not only referred to the main workflow but also to the instrument itself, acting directly on BIM software. The dynamic adaptation of open source solutions to specific HBIM purposes has been proved through the custom exploitation and utilization of FreeCAD (Diara & Rinaudo, 2020). At the same time, for cloud-based platforms the goal should always be their adaptation towards archaeological data.

Like the already mentioned solutions, an ideal cloud-BIM platform for archaeology should have three types of users (Fig. 1): a project manager; invited users; public users. The first one should be in charge of the project design, data management, revisions, updates and validations processes (apart from analyses and queries).

The project manager invites selected users for collaborations and for a multidisciplinary approach, as they would be delegates for analyses, queries, revisions and updates; at the end, the project should be available to public users for data analyses and queries, in order to spread knowledge and offer the possibility to interact with it.

For the purpose of integrating archaeological data into online platforms, DBMS storage management should be planned and organised to collect different types of data (Fig. 1): Archaeological stratigraphy; Stratigraphic analysis; Chronological interpretation via Matrix; 2D graphic drawings; Photographic details; Iconographic references; Bibliographic references.

Cloud-based BIM solutions for archaeology should integrate and must be able to investigate this kind of sensitive data (Fig. 1), from alphanumerical data (stratigraphic analysis DBMS) to 2D drawings and photos, from material analyses to relational schemes (Matrix), and actual platforms can hardly host and query these data.

Moreover, the correct implementation of archaeological research into BIM workflows and related online platforms must take into account the exceeding of a strict IFC semantic classification for 3D objects, designed only for the AEC, of which a proper classification for Heritage assets will be hardly obtained.

The main goal should be mainly the stability of the project and then ensuring data sharing via online solutions, to fulfil the fundamental role of BIM methodology: data dissemination for a collaborative approach. Pathways, workflows, and software typology should be put in the background.

Another fundamental aspect is concerning the portability and accessibility of information. Mobile devices play an important role for the portability and easiness of managing HBIM semantic data (Balletti, Bertellini, Gottardi, & Guerra, 2019), especially when laptops could be considered both desktop and mobile machines. In this way, DBMSs and 3D spaces should be consultable in every place and every moment, avoiding having to carry out analyses in specific places with particular instruments, for example laboratories and dedicated computers.

HBIM projects, designed for the knowledge of historic contexts, should be guaranteed to public use through ad-hoc platforms, as well as accessible with ad-hoc solutions in order to involve different types of audience. For example, online BIM solution via mobile devices coupled with AR or VR could offer excellent support for information access (Banfi, Brumana, & Stanga, 2019; Banfi, 2020).

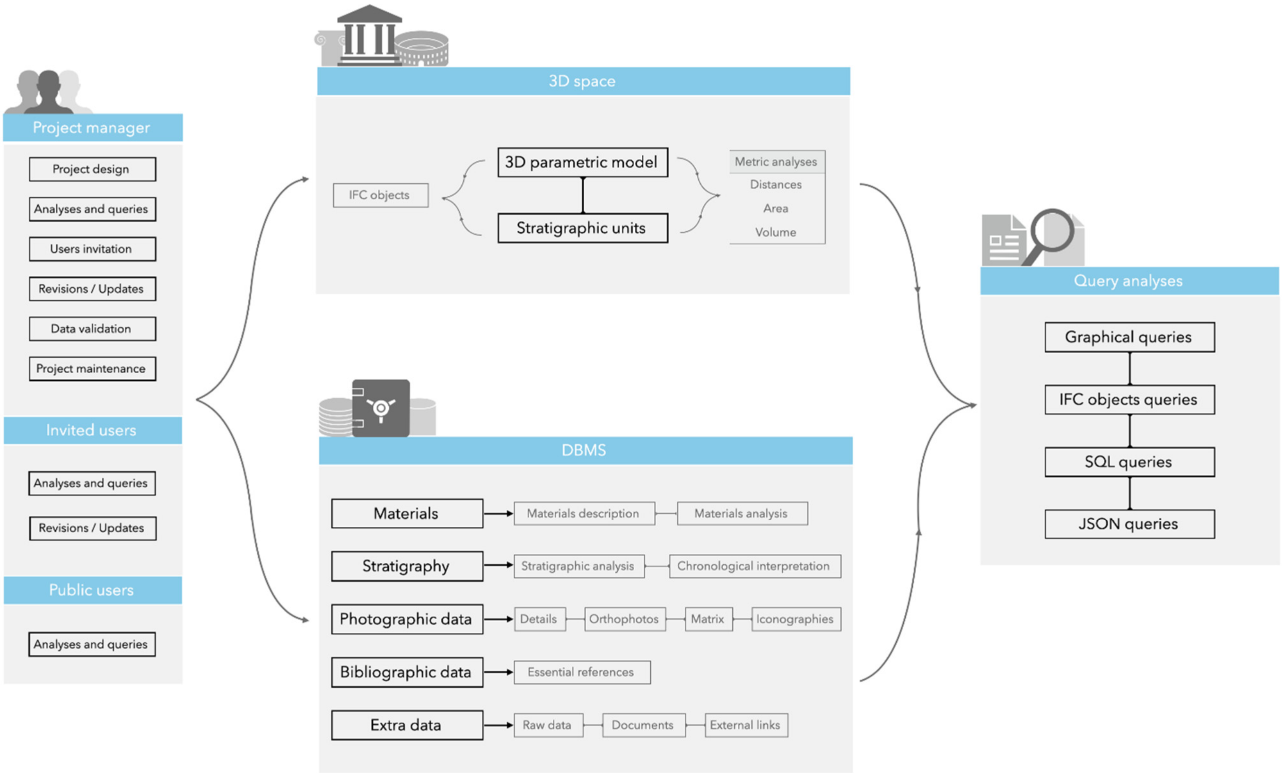

Figure 1: Ideal cloud-based BIM platform for archaeology.

Online data sharing is apparently the last moment of traditional scan-to-BIM workflows for Cultural Heritage assets: from knowledge processes (mostly characterized by surveys) to data management, from the design of the BIM platform to data sharing (Fig. 2). Regarding archaeological studies, data sharing moment must initiate required revisions and validation processes, apart from pure data sharing for public users.

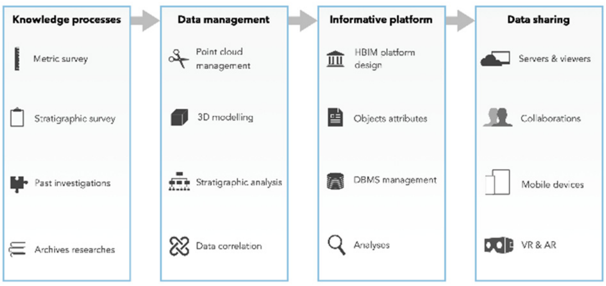

Figure 2: Main steps from knowledge processes to data sharing via BIM methodology for archaeological contexts.

Looking at the actual solutions mentioned before, BIMData.io platform might be the most flexible and customizable online solution for archaeology, especially if accompanied by a proper development process through other open source packages (XEOKIT – XEOGL – ThreeJS).

4. Conclusions

The individuation of a suitable and smart solution for the online publication of archaeological researches based on BIM methodology has been the initial reflection that has led and will lead this work in-progress research.

Cloud-based platforms as web-servers and advanced online viewers have a big responsibility in order to ensure a collaborative, open and stable approach with different kind of users especially since the online dissemination has proved to be essential in these challenging times, where remote accessibility is often revealed the only possibility to carry out and update researches and analyses.

However, the sharing moment should not be considered the final step of analyses but it must be seen also as a new beginning to review and update researches. For this reason, the entire BIM and HBIM workflow can be considered a cyclical process (Fig. 3) and mobile access should serve as a guide to online sharing.

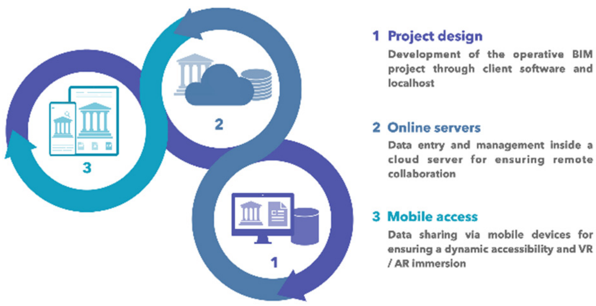

Figure 3: From project design to mobile access for HBIM.

Experimentations and customization of BIMData.io platform may be the focus of future research, also trying to develop a proper FOSS online solution for archaeology.

Acknowledgements

This project is supported and funded by the GAMHer project (Geomatics data Acquisition and Management for landscape and built Heritage in a European perspective), a 3 years project financed under the Italian PRIN 2015 framework (Progetti di Ricerca di Rilevante Interesse Nazionale).

References

Balletti, C., Bertellini, B., Gottardi, C., & Guerra, C. (2019). Geomatics techniques for the enhancement and preservation of Cultural Heritage. *Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XLII-2/W11*, 133-140. https://doi.org/10.5194/isprs-archives-XLII-2-W11-133-2019

Banfi, F., Brumana, R., & Stanga, C. (2019). Extended reality and informative models for the architectural heritage: from scan-to-BIM process to virtual and augmented reality. *Virtual Archaeology Review, 10*(21), 14-30. https://doi.org/10.4995/var.2019.11923

Banfi, F. (2020). HBIM, 3D drawing and virtual reality for archaeological sites and ancient ruins. *Virtual Archaeology Review, 11*(23), 16–33. https://doi.org/10.4995/var.2020.12416

Diara, F., & Rinaudo, F. (2018). Open source HBIM for Cultural Heritage: a project proposal. *Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XLII-2,* 303-309. https://doi.org/10.5194/isprs-archives-XLII-2-303-2018

Diara, F., & Rinaudo, F. (2020). Building archaeology documentation and analysis through open source HBIM solutions via NURBS modelling. *Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XLIII-B2-2020*, 1381-1388. https://doi.org/10.5194/isprs-archives-XLIII-B2-2020-1381-2020

BIMData Platform. (2020). The BIM collaborative platform of BIMDATA.IO. Retrieved March 15, 2021, from https://bimdata.io/

BIMserver.center. (2020). BIM en la nube de CYPE Ingenieros, S.A. Retrieved March 15, 2021, from https://bimserver.center/es

GitHub, Inc. (2021). GitHub: Where the world builds software · GitHub. Retrieved March 15, 2021, from https://github.com/

Logothetis, S., Karachaliou, E., Valari, E., & Stylianidis, E. (2018). Open source cloud-based technologies for BIM. *Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XLII-2,* 607-614. https://doi.org/10.5194/isprs-archives-XLII-2-607-2018