IMPLEMENTING A LANDSCAPE INFORMATION MODELLING (LIM) TOOLFOR PLANNING LEISURE FACILITIES AND LANDSCAPE PROTECTION

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Abstract
Building Information Modelling (BIM) is growing in the Architecture, Engineering and Construction (AEC) Industry. With the new strategy to mandate BIM, there is a need to identify its importance in architectural landscape design. It has the potential to challenge some of the limitations of designing, constructing and managing the built environment. Using BIM tools and applications, landscape analysis can be explored, developed and documented for design, planning and organization as well. This application, known as Landscape Information Modelling (LIM), may store object information such as: irrigation pipelines; areas allocated to specific plants; list of different plants involved in landscape projects; *etc*. Annotations used in landscape drawings would be accompanied by information attached to it. In this paper, a first application of LIM aimed to landscape protection has been implemented, so as to help in planning leisure facilities. Indeed, with many details involved, it can also be used to store data for landscape architects, who would easily develop and organize detailed information. Hence, with the ability for simulation and visualization, they should be able to produce detailed plans, walk-through animations and renderings for presentation, while exploring the scope and nature of work and making informed decision at early design stages.

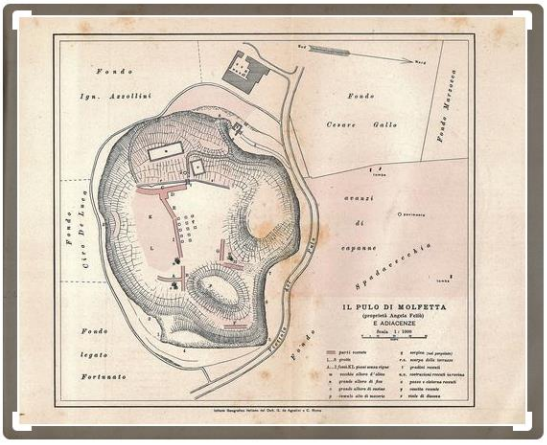
Key words: Built environment; Public recreation; AEC Industry; Landscape architects; BIM

Introduction

Building Information Modelling (BIM) is growing in the Architecture, Engineering and Construction (AEC) Industry. With the new strategy of many European Governments to progressively mandate BIM, there is a need to encourage BIM adoption in architectural landscape design as well. The use of BIM best practices can lead to efficient and effective BIM collaborative technology and partnering. BIM has the potential to challenge some limitations in designing, constructing and managing the built environment (Ahmad & Aliyu, 2012).
Landscape Information Modelling (LIM) is the process used in landscape architecture discipline which have specific objectives, principles and methodologies in conservation and management. It is necessary to explore an integrated information framework to facilitate the digital management of cultural landscape information (Yang et al., 2019). Anyway, even if increasingly popular among landscape architects and urban planners, an information model in the way of BIM seems to be still missing in landscape design (Borkowski & Wyszomirski, 2021). A LIM application would include: quantity counts; error reduction with organization of data; smart symbol use; landscape presentation (plants) before they eventually grow; storing data; site information modelling; cutting and filling sites (site analysis details); assigning plants types at areas that suit their nature (site analysis details); and exploring and presenting ideas to clients. (Ahmad & Aliyu, 2012). In the present paper, a first application of LIM aimed to landscape protection has been implemented in an environmentally-sensible study area, so as to help in planning leisure facilities and landscape management.

Material and methods

The study area is the “Pulo di Molfetta”, a doline located two kilometers south-west of the city of Molfetta (Apulia Region – Southern Italy). It consists of an oval shape karst depression of 30 m, having diameter variable in the range [130–170] m (Figures 1, 2). In the vertical calcareous walls, several grottoes open, located at different heights, often communicating each other through a series of galleries. In the pre-protohistoric period, the site was used for cultural funerary activities.



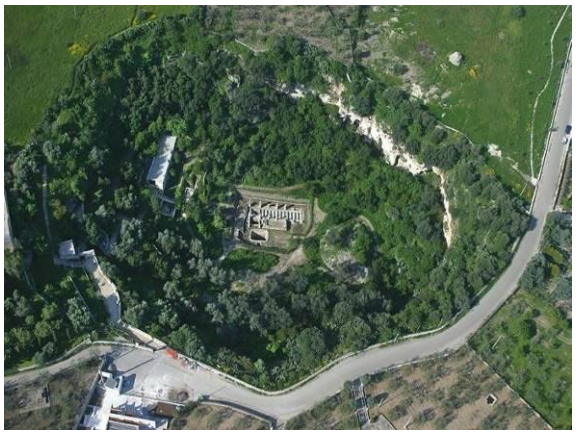


Fig. 9: Doline plan drawn up by M. Mayer (1901) Fig. 2: Overview of the Area

The findings discovered during the archaeological works carried out from 1997 to 2003 are of significant historical and architectural interest, since they revealed complexes of factories datable to the Bourbon period, located at various levels from the middle to the bottom of the Pulo (Figure 3).
Following the studies carried out afterwards, it has been possible to attribute the pre-industrial structure, located at the middle level, as the *"Regia Nitriera*" (Royal Saltpeter Factory) constructed in 1784 (Figure 4). The caves were rich in potassium nitrate or saltpetre, very requested and extracted during the Kingdom of Naples and used as component of explosive for guns and mines. The plant remained active for some decades and then was closed due to its low productivity. In fact, since 1808, it was described as already totally abandoned.

For a detailed representation of the entire environment of this area, a dedicated LIM model was developed. In fact, compared to a classical BIM model (purely architectural), current LIM consists of a three-dimensional digital model, not only of the terrain but also of the historical and architectural parts present within the site. The modelling has been realized with the software BIM Autodesk Revit that, in combination with Office tools, allows the creation of an interactive environment, where it is possible to interrogate every element, obtaining all associated information (Figure 5). This model itself is a database that contains a variety of site data, attributable to three macro areas: Landscape, Architecture and History.

Fig. 3: Nitrous soil leaching tanks at doline bottom

Fig. 4: "Regia Nitriera" (Royal Saltpeter Factory)

Fig. 5: Revit property tab of the topography

Landscape

The first step was to create the three-dimensional model of the terrain, starting from the contour lines of the site (Figure 6). This three-dimensional element has been populated with all the necessary information, *i.e.*:

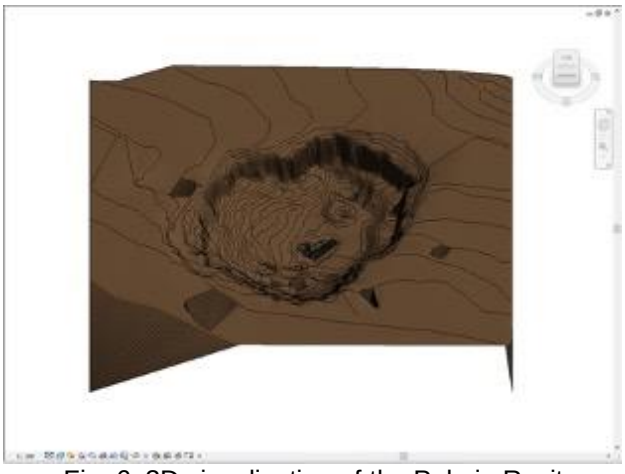


Fig. 6: 3D visualization of the Pulo in Revit

topographic survey and GIS database; Technical/administrative framework: economic/maintenance reporting framework; historical cartography data; level of rurality; photographic survey; type of soil; chemical composition; flora and fauna.

Architecture and History

Buildings and architectures, historical and not, have been surveyed and reported in three-dimensional elements, under the form of walls and floors. Each modelled element brings with it a deepening, with BIM parameters reporting: technical/economic data; technical-administrative data; architectural and photographic surveys; physical data on materials; data (if any) on the structural composition. Regarding the historical part of buildings, the following additional elements have been considered: historical info and state of conservation; chemical/physical data from specific surveys (*e.g.:* thermo-scanner); possible information on the seismicity of the place; indications on conservation and

maintenance methods. Another step of the work has been the creation of a schedule, intended to help to know what is present in the area, the quantities of each single category of elements. All the information is accessible in a single work environment. It can be shared and accessed by everyone through IFC formats, and can be exported to document formats such as XLS and PDF.

Results

The large database of information which has been created thanks to the use of a LIM, seems to constitute a very powerful tool for facilitating the area's manager in their daily work, that would be, otherwise, complicated to manage and control. This LIM enables indeed the graphical representation of the whole area, including every connected information relevant to the environmental, cultural, historical, landscape, etc. characteristics (Figure 7).

All these information may contribute in this way to the best planning, design and management of an area - like this one considered in this study - having an extraordinary value from several different point of view. This LIM represents therefore a digital representation of tangible and intangible components of a landscape. It constitutes a shared knowledge resources for information about a landscape, forming a reliable basis for decision in the management processes including heritage/environment assessment, conservation plan, monitoring impacts and assessing changing circumstances (Picuno C.A. et al., 2017).

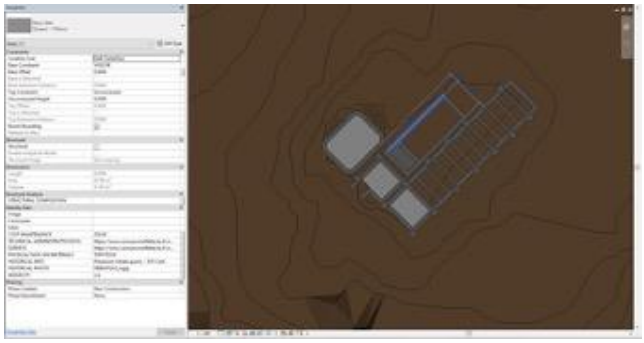


Fig. 7: Property tab and plan view of the Saltpeter Factory in Revit

Discussion

The LIM model is capable to give not only the 3D information, but to go beyond, expanding the number of dimensions to other additional levels (Figure 8).

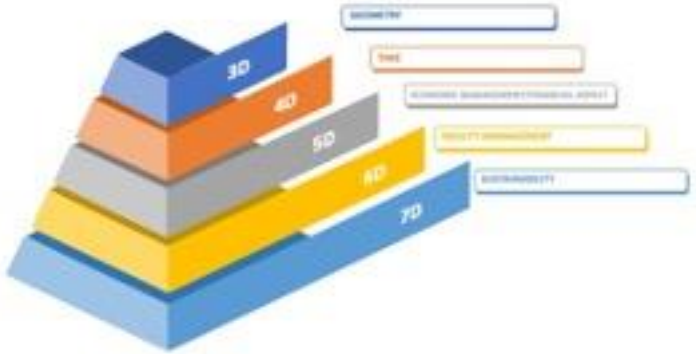


Fig. 8: The 7 dimensions in BIM and LIM projects

The timely availability of this information gives the operator the ability to make strategic decisions about interventions that may be:

- Grafting new species of threes, knowing the terrain;
- Planning a new strategy for cultural heritage valorization (Godosi et al., 2021), knowing the history of the place and identifying the most suitable areas for public recreation and leisure facilities;
- Planning the financial costs of future interventions and its frequency, knowing all the technical specs and the quantities;
- Safeguard the flora and fauna, knowing its peculiarities.

All these activities can be defined by the LIM model, providing tools and empowering decision-making team to do a thorough multidisciplinary work.

Conclusion

This paper presents a preliminary work on the design of a landscape information model applied in a environmentally-sensitive area. It is expected to be implemented with additional data and information obtained as a result of interventions undertaken by the Municipality of Molfetta for the exploitation and fruition of the whole area. Benefits of this LIM would be: (i) the formalization of knowledge in landscape design; (ii) information model to support multiple participants in landscape design process; (iii) improved information exchange and integration between landscape design, architecture and urban design.

References

Ahmad A.M., Aliyu A.A. (2012). The Need for Landscape Information Modelling (LIM) in Landscape Architecture. "GeoDesign, 3D Modeling and Visualization (13th Digital Landscape Architecture Conference), Bernburg, May 2012.

Borkowski A.S., Wyszomirski M. (2021). Landscape Information Modelling: an important aspect of BIM modelling, examples of cubature, infrastructure, and planning projects. Geomatics, Land management and Landscape No. 1 • 2021, 7–22. http://dx.doi.org/10.15576/GLL/2021.1.7

Godosi Z., Papadiotis T., Fatone A., Picuno P. (2021). Connecting marinas with inland areas for enhancing the public recreation of rural heritages. Proceedings of the Conference on: "Public Recreation and Landscape Protection: with sense hand in hand?", Křtiny (Czech Republic), 10-11 May 2021, 99-103.

Picuno C.A., Laković I., Roubis D., Picuno P., Capetanović A. (2017). Analysis of the characteristics of traditional rural constructions for animal corral in the Adriatic-Ionian area. Sustainability, 9, 1441. DOI: 10.3390/su9081441.

Yang C., Han F., Wu H., Chen Z. (2019). Heritage Landscape Information Model (HLIM): towards a contextualized framework for digital landscape conservation in China. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XLII-2/W15, 2019 27th CIPA International Symposium "*Documenting the past for a better future*", 1–5.9.2019, Ávila, Spain.

Zajíčková V, Achten H. (2013). Landscape Information Model: Plants as the Components for Information Modelling. Building Information Modelling – Vol.2 - Computation and Performance - eCAADe 31, 515-524.

Souhrn

Informační modelování budov (BIM) se jako jeden z nejnovějších trendů ve stavebnictví rychle stává klíčovým přístupem k digitální integraci informací potřebných pro navrhování, výstavbu a správu objektů. V současných projektech BIM a integrovaných projektových a stavebních postupech je však informační modelování pozemků (LIM) podceňováno. Krajinářští architekti by se měli orientovat na BIM. Je obtížné určit specificky BIM software pro krajinářské architekty, to vytváří potřebu, aby se krajinářští architekti spojili a požadovali software, vytvořili trh pro dodavatele softwaru, realizovali výrobu krajinářského BIM softwaru, se specifičtějším krajinářským softwarem by krajinářští architekti mohli být schopni poskytovat inovativnější projektování s efektivními kompetencemi a efektivně spolupracovat s ostatními uživateli BIM. V tomto článku byly analyzovány dva účely BIM - tj. vizualizace fyzických aspektů krajiny a pochopení neviditelných aspektů krajiny. Na základě těchto dvou účelů je ontologie zásadním problémem LIM. Byly identifikovány dvě skupiny složek krajiny: 1) místa zahrnující terén, terénní podmínky, počasí, mikro- a makroklima atd.; 2) krajinné objekty zahrnující "měkké" materiály (např. vegetaci) a "tvrdé" materiály (stavební objekty). Podobně lze navrhnout kombinaci některých základních krajinných prvků: reliéfu, vegetace, vody, staveb a atmosféry.

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