Chapter 40
Semantic Representation of Accurate Surveys for the Cultural Heritage:
BIM Applied to the Existing Domain

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ABSTRACT

For years the traditional documentation of existing architecture has been represented by surveys, carried out with direct measuring, annotations and eidotypes. This approach is still pervasive today, but many modern metrologic technologies, such as digital photogrammetry and terrestrial laser scanning, enhanced the information-gathering pipeline particularly in the Cultural Heritage context. This chapter investigates a methodology able to express semantics and parametric interconnections among elements, proposed in order to translate real shapes into "smart" digital architectural components, using some piece of software specifically written in order to manipulate accurate geometries; following this approach, which will be improved more and more by future plugin developments, information can be organized into proper hierarchical BIM frameworks that proved to be strategic in the recording of "as-built" conditions, result of inferences of geometric and topological information in digital models.

INTRODUCTION

In scientific literature, a lot of papers have been written over the years about digital techniques applied to the protection, documentation and understanding of humanity's shared Cultural Heritage, particularly in the architectural and archaeological fields, which historically count the majority of case studies related to the application of hardware and software as they are commercially released (Garagnani and Mingucci, 2011).

Since computers became so powerful to edit and process huge quantities of geometric and hyper textual data, the digital domain has been investigated in order to find more and more effective systems aimed at the knowledge management.

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Wide databases and huge amounts of different media are easily collected by computers and embedded in three-dimensional models, which can be explored by means of text queries or visual navigation.

From still pictures to interactive panoramas, from alphanumeric archives to hyper-linked records, several studies were carried out to find the best way possible to convey the knowledge pertaining time and place.

A relatively new concept, provided to display information required in the design, construction and operation of constructed facilities from their inception onward, will be examined in this chapter in order to extend its potential to existing buildings and monumental sites. This concept is generally referred as *Building Information Modeling* (BIM).

When a computer-generated model contains precise geometry and relevant data needed to support the construction, fabrication and procurement activities needed to realize a building, it is supposed to be a *BIM model* and the interaction with it by different actors determines a *BIM process* (Eastman, Teicholz, Sacks and Liston, 2008).

The term BIM was commercially introduced in 2002, when Autodesk abandoned the use of "Single 3D Building Model Technology (SBM)" in favor of it in its strategic master plan for the market. The same year Cyon Research used the term in a white paper about the software called ArchiCAD by Graphisoft that, until that moment, was referring to "Virtual Buildings". In the December 2002 issue of his newsletter, Jerry Laiserin suggested to adopt universally the acronym BIM for this kind of technology.

Even if Charles Eastman is considered a pioneer in BIM implementation and the inventor of its acronym (he used for the first time it in late '70s), plenty of authors wrote and collected different definition for this process; according to the international standard ISO 29481-2 for example, Building Information Modeling can "bring together the diverse sets of information used in construction into a common information environment, reducing, and often eliminating, the need for the many types of paper documentation currently in use."

On the other hand, the National Building Information Model Standard (NBIMS), a consensus based code of standards developed in the United States of America, defines BIM as a "digital representation of physical and functional characteristics of a facility, which serves as a shared knowledge resource for information, determining a reliable basis for decisions during its whole life cycle."

The Australian National Guidelines for Digital Modeling (CRC Construction Innovation, 2009), define BIM as a brand new approach to design, construction and facility management in which a digital representation of the building process is used to ease the interoperability of information in digital format; these guidelines state that "a model needs only two essential characteristics to be described as a BIM model. The first is that it must be a three-dimensional representation of a building (or other facility) based on objects, and second, it must include some information in the model or the properties about the objects beyond the graphical representation."

It is clear that the BIM approach is completely different from CAD drafting, since three-dimensional models without information, whether based on objects or graphic primitives such as lines, polylines, arcs or circles used to represent architectures, may still be useful but they do not qualify as models completed by any sort of information different from the geometrical one.

Therefore, BIM has not to be considered as a set of software but, on the contrary, as a pipelined process among designers, managers, engineers, architects and contractors, sharing a common language made of 3D digital representations of knowledge embedded on a framework at their complete disposal, even if this entire potential is still far to be fully appreciated in professional practices.